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THE SYRIANS OF PERSIA AND EASTERN TURKEY.

BY

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It is the purpose of this paper to describe as briefly and accurately as possible the origin, the condition, and the numbers of the so-called Syrian Christians living in the vilayets of Van and Mosul, in Turkey, and in the regions adjoining Lake Urumia, in Persia. It is difficult to get an altogether suitable national designation. Perhaps the name most commonly used has been Nestorians; but this is a religious name. In the past, at least, many Nestorians were of other races, and large numbers to-day are not Nestorian at all. The name Assyrian has also been used, but never by the people themselves. It depends upon a historical hypothesis that is very likely correct, but which is not capable of absolute proof. The people call themselves *Surayi* or *Suryayi*, and the name Syrian is therefore the natural one to use, though it is objectionable on account of the confusion likely to arise from its connection with the country of Syria. This may be partially obviated by using the term Eastern Syrians.

Their origin is an interesting and obscure historical problem. We may dismiss at the outset the attempted identification with the Ten Tribes of Israel. This theory, which was started by the pioneer missionary Dr. Asahel Grant, has, in the minds of some, invested the people with a fictitious, sentimental interest. It is based on a supposed tradition among the people themselves and upon certain resemblances in customs to the Jews. The alleged tradition, however, is very infrequently met with, and nothing in Syrian history supports the conjecture. The data on which to base a theory are tradition, language, monuments, and literature. The Syrians living in Persia appear, whenever they have any tradition

on the subject, to say that their ancestors were immigrants from some other locality, and generally from the Kurdish mountains, very commonly either Jilu or Shemisdén. In a few cases tradition points to emigrants from Maragha, on the eastern side of Lake Urumia. The Syrians living in Turkish Kurdistan have traditions of various migrations from one district to another within the general region, showing that the population has shifted in the past centuries. The most ancient centres of population—*i. e.*, the points from which migrations seemed to have emanated largely—are Jilu and Tiari. One also finds a widespread tradition that their ancestors came from the plain of the Tigris, in the region of Mosul and Arbil; while, so far as I know, the Syrians of the Assyrian Plain have no traditions of immigration into that region. There is also a general belief that the mountains were entered for the sake of refuge from persecution. All speak the Syriac language, though the dialects used differ considerably, and all differ so much from the classical Syriac that scholars incline to the view that the spoken Syriac is not directly derived from the written Syriac of former ages. The Syriac centres of learning were Edessa and Nisibis, so that the literary Syriac was in agreement with dialects spoken west, and not east, of the Tigris, and in the old literature there are references to dialectical differences then existing. The dialectical differences of the spoken Syriac are reducible to a few groups. One is the dialect of the Tigris plain, with various subdivisions. Another is the dialect of the southern mountain districts, centering in Tiari, and including some branches within the region generally occupied by the third group. This group centres in Jilu, and includes the northern districts in Turkey and all of those in Persia. It will be seen that tradition and language agree in pointing out Tiari and Jilu as ancient centres of population. The monumental remains are all churches, and contain very few inscriptions. The age assigned by tradition to these churches is very unreliable. The old churches in Persia are not numerous, and none of them can be proved, I think, to be older than the Mongol period; and possibly none is even as old as that. The literature remaining in old Syriac has been too imperfectly examined to make it possible to speak dogmatically of the evidence contained in it as to the Christians of the regions we are considering.

The following facts are collected mainly from that treasury of Syriac lore, *Assemani Bibliotheca Orientalis*. The Nestorian Metropolitan bishopric of Azerbaijan does not appear to have been as ancient or as prominent as others within the present

bounds of Persia, or farther east, especially Khuzistan, in southern Persia, and Merv and Khorasan, in the east. The latter are mentioned frequently from the beginning of the Moslem era, but the first mention of the former is in the tenth century. It is altogether likely, however, that the Christian religion was introduced at an earlier date, for in the beginning of the ninth century Nestorian missionaries were very active in Dailam, Ghilan, and Moghan, to the east and north of Azerbaijan. When Tabriz and Maragha became capitals of the Mongol power the importance of this diocese in both the Nestorian and the Jacobite churches increased, and large churches in Tabriz, Ardebil, and Urumia, which have been converted into mosques, probably date from this period. The Nestorian episcopal dioceses of Urumia, Salmas, and Ushnuk are first mentioned in the twelfth or thirteenth centuries. That there were Christians in the Hakkari district of the Kurdish mountains in Turkey is evident from the early references to the bishops of Baghash, the ancient Syriac name for the region; but there is no reason to infer that the diocese was considered important until the present line of patriarchs took refuge there in the seventeenth century. The most probable conclusion from these scraps of evidence would appear to be that the Syrian Christians living in Persia are mainly descendants of immigrants from what is now Turkish territory, that these immigrants came within the last three centuries, and that some are descendants of Christians who have lived in these regions for perhaps a thousand years. Those of Turkey are, similarly, the descendants of refugees from the Tigris valley and of Christians who have lived in the mountain districts, near the upper Zab, from very early times. These migrations have been caused by political conditions and by religious persecutions. The mountains have offered refuge from the anarchy that has so often devastated the plains of Nineveh, and the Persian plains have offered comparative quiet to the sufferers from Kurdish lawlessness. Ultimately, therefore, the Syrians of these regions are descended from the Semitic, Syriac-speaking people who lived in ancient Assyria, and are of the same race as the Syriac and Arabic-speaking Christians now living in the valley of the Tigris. Inasmuch as the present Christian population is the remnant of a much larger Christian body, which included some of Turkish and Kurdish race, it is likely that they are not purely Semitic; and to this fact may be due the rather large variety of physical types observable among them.

The Syrians may be divided, with respect to their political con-

dition, into four main groups: those subject to the Persian Government, the semi-independent mountain tribes that are partially subject to the Turkish Government, those living in mountain districts that are completely under Turkish rule, and the Syrians living in the Tigris valley. The last group we shall not notice further.

The first mentioned live in the three plains of Urumia, Salmas, and Sulduz, bordering on Lake Urumia, and in the three little plains of Mergawar, Tergawar, and Baradost, just under the lofty mountains that form the boundary between Persia and Turkey. The largest number are farmers, working the lands of the feudal nobility. The direct taxes paid by them are insignificant in amount, but the amount that goes to the landlords is excessive. In irrigated lands the amount paid by the farmer is generally two-thirds of the produce of grain fields, if the seed is furnished by the landlord, and one-half if he furnishes the seed himself. In lands not irrigated the rule is that the farmer furnishes his own seed and gives to the landlord one-eighth of the grain. Besides this, he has also to furnish the landlord a very indefinite amount of unpaid labour. This last, and the fines assessed by the landlord and the regular Government officials, with the bribes demanded by them, are the most prolific sources of injustice. The vineyards, which make up a large part of the wealth of the Christians, and contribute largely to its increase, are held by a tenure much more favourable to the cultivator. The raisins, which are the most valuable product of the vineyards, are exported to Russia, and, in lesser quantities, to western Europe, *via* Trebizond. A considerable number of the Syrians are masons and carpenters; but very few engage in trade, being, in this respect, in marked contrast to the Armenians, and also to the Syrians of Mosul. The most marked feature of their industrial condition, to which is due much prosperity and also much demoralization, is the wholesale migration of the men to Russia for temporary employment. Every year thousands of Syrians cross into Russia to find work. The development of Transcaucasia, with the building of the cities of Tiflis, Batum, and Baku, has created a demand for labourers, skilled and unskilled, and Syrian carpenters, masons, and day-labourers have found lucrative employment. Not a few, too, have become contractors and employers of labour, some on a large scale. The recently-completed Tiflis-Kars-Erivan railroad was built very largely by Syrian workmen and Syrian contractors, who are now looking forward eagerly to the extension of the line to the Aras river, and ultimately across the border into

Persian territory. Others find work as porters and water-sellers in various Russian cities. Hundreds more are small shopkeepers or itinerant peddlers. Another occupation is begging. The credulity, religiousness, and kindheartedness of the Russians make their country a peculiarly rich field for pious frauds, who travel all over that great land, from Kiev to Vladivostok, in various and shifting guises. Some are just arrived from Jerusalem, and display holy relics to enforce their appeals; others tell tales of Moslem oppression, which, very likely, have a foundation in fact; others simply beg their bread and small sums of money from door to door. The excursions of the more enterprising are not confined to Russia, nor, indeed, to any country. Some of them, as eye-witnesses, told queer tales of the fighting of the allies in Peking, and of affairs in Manchuria. The effect of such a life, separating the men for months and years from their families, and subjecting them to most demoralizing influences, may easily be imagined.

The mountain region between the upper course of the River Zab and the Persian border is very rugged, and contains only very deep and narrow valleys, except the lofty plain of Gawar. These valleys are inhabited by Kurdish and Syrian clans that own their allegiance to the Sultan within their mountain country only by paying an irregular and very inconsiderable tribute. Disputes between individuals and communities are settled by a primitive code of tribal law, enforced by the strong arm of the people themselves. Their wealth consists almost entirely in sheep, and these are the objects of frequent inter-tribal raids. Unlike the Kurds, none of the Christians are nomadic, although they spend the summer months as much as possible in the mountain encampments, where the sheep are kept. The narrow valleys are terraced, and so fields are made, which are sown with millet, Indian corn, potatoes, and other products. The fields are popularly measured by the number of hatfuls of seed required to sow them. In some of the valleys rice is also cultivated to a considerable extent. The people of Tiari seldom go out of their own territory, but in the other districts an industrial condition obtains not unlike that already described. Instead of going to Russia for work, the men go for the winter to the plains to the south and find work in the large cities, from Mosul to Aleppo and Damascus, especially as stonemasons and basket-makers. Some, again, are vagrant beggars. One village in Jilu supports itself almost entirely in this way. It would be hard to find anywhere another such community as this village of Mar Zaya. In a most picturesque and rugged valley, in the shadow of a massive old church, reputed by

tradition to be fifteen hundred years old, apparently shut off from the world as completely as in a prison, one may hear the men tell of their adventures in every part of the world—Australia, America, China, Africa, and Europe. In order to show that this is in no way exaggerated, let me add that the present writer has seen letters from or concerning these men from Austria, England, America, Dahomy, Cape Colony, India, and South America. In general, it is impossible for these communities, living in such rugged regions, maintaining a precarious independence of Government control, and constantly embroiled in tribal wars with each other and with the Kurds, to prosper in material resources.

Most miserable of all are the Syrians living in or near the mountain districts under more complete Government control. During the past fifty years the Turkish Government has gradually extended its authority in the mountain districts. The power of the great Kurdish chiefs has been broken, and, one after another, districts have become *rayat* instead of *ashirat*. The result ought to be increased security and prosperity; but, unfortunately, it is not. Taxation is heavier than before, and is strictly enforced, the intricate procedure of law courts is substituted for the rude and summary process of revenge, the towns are garrisoned with disciplined troops, but the Kurdish robber is as rapacious, if less conspicuous, than before. The consequent state of affairs is deplorable in the extreme, and not a few districts are becoming depopulated of Christians. In general, the industrial condition is most wretched. Many, of necessity, become beggars in the more prosperous Christian villages of Persia or the Tigris valley, or they obtain Persian passports and wander off to Russia. Many an old church, either deserted or sheltering in its shadow a handful of wretched people, bears mute but eloquent testimony to former and happier days.

As a whole, the Syrians have not been slow to avail themselves of opportunities to improve their condition; and it may confidently be expected that in the opening of the projected Bagdad railroad they will profit far more than the Kurds and Arabs of the regions traversed. Both in Turkey and in Persia the Governmental conditions are growing worse with time; but even more rapidly the Christians are growing in sensitiveness to wrong as they grow in intelligence. From this, more than any other cause, arises the desire to emigrate, and each year families remove to Russia, and the tide is beginning to flow towards America as the freest of all lands.

Without making any claim of more than approximate accuracy, it is believed that the following estimate of population is not far

from the truth. It is based on lists of villages and numbers of families, derived in most cases from more than one source, either from intelligent natives or from missionaries who have travelled through the regions under consideration.

I. PERSIA:

Plain of Urumia.....	90	villages.	4,900	families.	24,500	souls.
" " Sulduz.....	8	"	100	"	500	"
" " Salmas.....	4	"	400	"	2,000	"
" " Tergawar.....	18	"	800	"	4,000	"
" " Mergawar.....	6	"	100	"	500	"
" " Baradost.....	2	"	50	"	250	"
	<u>128</u>	"	<u>6,350</u>	"	<u>31,750</u>	"

In the above the families have been reckoned as containing five heads in each one. Below they will be reckoned at seven each, as there is far less division of sons from their father or brothers from each other among the mountain than among the plain Syrians. In many villages in Persia the Syrians live beside Moslem neighbours; but in Turkey this is rarely the case, and the villages are entirely Christian or entirely Moslem.

II. TURKEY—SEMI-INDEPENDENT TRIBES:

Jilu.....	14	villages.	555	families.		
Baz.....	7	"	375	"		
Diz.....	11	"	170	"		
Tkhuma.....	5	"	750	"		
Tal.....	6	"	230	"		
Tiari.....	40	"	1,720	"		
	<u>83</u>	"	<u>3,800</u>	"	26,600	souls.

III. TURKEY—DISTRICTS UNDER GOVERNMENT RULE (RAYATS):

Region of Gawar.....	21	villages.	680	families.		
" " Bashkala and Van.	22	"	520	"		
" " Julamerk.....	10	"	200	"		
Nochea, etc. (near Persian border south of Gawar)...	15	"	270	"		
Rakan, Chal, etc. (north of Zab, near Amadia).....	14	"	310	"		
Region around Amadia south of Zab.....	45	"	1,205	"		
	<u>127</u>	"	<u>3,185</u>	"	22,295	souls.

These figures give a total of 338 villages, 13,335 families, and 80,645 souls, to which may be added some 30,000 living in the valley of the Tigris, making a total of about 110,000 souls, though I cannot vouch for the correctness of the figure for the Tigris valley.

# THE MISSISSIPPI RIVER FROM CAPE GIRARDEAU TO THE HEAD OF THE PASSES.\*

BY

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**OCCURRENCE OF HIGH-WATER STAGES.**—The early floods of the year come mostly from the eastern rivers, and usually culminate in March; while the western rivers generally cause a flood in June. An intermediate rise in May is not uncommon when a late rise of the eastern tributaries coincides with an early rise of the western. Great floods occur at intervals. The following table estimates the average conditions (Reports '83, 26):

STATION.	YEARS.	FLOODS.	HEIGHT OF FLOODS EXPECTABLE ONCE IN 10 YEARS.
Cairo.....	1862-1883	4 reached 50.8 ft.; highest, 52.4	51.5
Memphis.....	1858-1883	6 reached 34.0 ft.; highest, 35.2	34.5
Helena.....	1867-1883	6 reached 45.8 ft.; highest, 47.2	46.5
White River....	1862-1883	5 reached 46.6 ft.; highest, 48.5	47.5
Vicksburg.....	1858-1883	4 reached 48.8 ft.; highest, 51.1	49.0
Natchez.....	1858-1883	5 reached 47.9 ft.; highest, 50.3	48.0
Red River.....	1867-1883	3 reached 46.3 ft.; highest, 48.6	47.0
Carrollton.....	1859-1883	5 reached 15.9 ft.; highest, 15.9	15.6

**CAUSE OF HIGH-WATER STAGES.**—The most potent agent in producing floods in the Mississippi has been excessive rains. The waters of the river come from three main sources—the Missouri, the Ohio, and the Upper Mississippi. These rivers are placed in a table for comparison:

RIVER.	DRAINAGE AREA IN SQ. MILES.	AVERAGE AN- NUAL RAIN- FALL.	% OF RAINFALL DRAINING OFF.	% OF TOTAL DIS- CHARGE OF MISS- ISSIPPI SUPPLIED.
Missouri.....	541,000	20.9 in.	15	14
Ohio.....	202,000	41.5 in.	24	31
Upper Mississippi.	171,500	35.2 in.	24	18

The Missouri area has its rainfall in May and June, and is a cause of the late floods of the Mississippi. Although the Missouri has the largest drainage area, yet, because of the scant rainfall and

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the small percentage of run-off, due to an absorptive soil and drying winds, it is hydrologically the least important. It contributes only 14% to the total discharge of the Mississippi. It, however, contributes 60% of all the solid matter borne by the river. The Ohio valley has its heaviest rains in January, February, and March. Its largest tributaries, the Cumberland and the Tennessee, rise in the mountains, and have a copious rainfall, which adds enormous volumes of water to the Ohio. The Ohio is in the track of the storms which come from the Gulf; and although its basin is less than one-half of that of the Missouri, it furnishes over twice as much water to the Mississippi. Melting snow and frozen ground are factors in this large percentage. The Upper Mississippi has its heaviest rainfall in May and June, and its rises unite generally with those of the Missouri. These three rivers yield 63% of the total discharge of the Mississippi. The remaining 37% of the discharge is divided among the other tributaries. The St. Francis, White, and Arkansas Rivers, draining the Ozark plateau, contribute about as much water as the Missouri. The Yazoo and Red Rivers, the remaining large tributaries, are too near the mouth to be dangerous.

The ordinary sequence of floods is, first, Ohio, then the Upper Mississippi, followed by the Missouri, with the western streams. All these rivers have never been known to be in extreme flood at once. Such a coincidence would produce a discharge of more than 3,000,000 cubic feet per second—twice as large as has ever been observed. The most dangerous conditions occur in early spring, accompanying the cyclonic storms which cross the country.

While excessive rains are the prominent cause of floods, a number of factors influence their value.

*a.* Condition of ground, whether frozen or vegetation-covered.

*b.* Condition of ground as to moisture. A slow rainfall of two inches extending over three days may produce only a very slight rise in a river, while the same amount in two hours may produce a very great one. A rapid rainfall forms a water surface over the ground, which promotes a rapid transfer of a great part of it to the stream. In summer the ground is so dry that in a slow rainfall there is little run-off.

*c.* Height at which the flood finds the lower trunk.

*d.* Duration of rise. A sudden rise up river flattens out as it proceeds down stream.

*e.* Local rainfall in the lower valley.

*f.* The clearing of forests has been shown (Russell, I. C., '98, 209) by experiments to have no direct effect in increasing river

stages. The increase in erosion, however, following the removal of vegetation, may so increase the load of a stream that disastrous floods result.

**EFFECTS OF HIGH-WATER STAGES.**—The increase in the power of the river during times of flood intensifies the scouring and cutting of the banks and precipitates cut-offs. The great disasters of floods come from the occurrence of crevasses and the discharge of the water over the surrounding country. The territory subject to submergence consists of certain basins along the river—the St. Francis, 6,706 square miles; White River, 956; Yazoo, 6,648; Tensas, 5,370; Atchafalaya, 8,109; and Pontchartrain, 2,001; aggregating 29,790 square miles. These rich bottom lands offer exceptional advantages to the pursuit of agriculture, and only as those already occupied continue to be populated, and others, sparsely settled because of the risk, increase in population as the danger is checked, can the great expense (for levees alone estimated in 1898 at \$34,310,795.34, with \$18,000,000 needed to complete the system) be justified.

The 1897 flood was considered an exceptional flood; 13,000 square miles of the basin lands were submerged, and the destruction of live stock and crops caused a loss of some \$13,000,000. In comparison with the 1882 flood, the waters of the 1897 flood were 22 days less above the danger line. It was remarkable, however, in that it remained a longer time at its highest stage. A comparison of the two floods is interesting.

STAGE OF THE RIVER.	1882.	1897.
River above danger line.....	81 days.	59 days.
River 2 feet above danger line.....	68 days.	56 days.
River 4 feet above danger line.....	63 days.	51 days.
River 6 feet above danger line.....	47 days.	47 days.
River 8 feet above danger line.....	15 days.	42 days.
River 10 feet above danger line.....	9 days.	19 days.

A flood moves as a wave down the stream. T. Russell states ('95, 211) that the wave moves with a velocity dependent on the slope of the river and the mean hydraulic depth, and does not differ a great deal from the velocity of the water. It is probably much slower. The crest of the 1897 wave showed on the hydrographs a progress from Cairo to Carrollton, 270 miles, at an average rate of 1 foot per second, while the average velocity of the river varies from 2 to 5 feet per second.

The difference in height between high and low water at St. Louis

is 37 feet; this increases to 51 feet at Cairo because of the Ohio; it then, with slight fluctuations, gradually decreases in amount until at the Head of the Passes the difference between high and low water is but 2.3 feet. The flood loses its power as it goes down stream, and a long river, therefore, cannot have a disastrous flood in its lower courses. The crest of the wave spreads out, and is, therefore, self-destructive.

Reference to Figure 9 will show that from the crest A to B the water will have a tendency forward equal to its normal flow under a similar

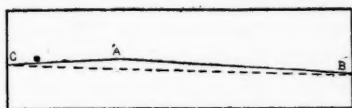


FIG. 9.

volume, and a normal slope *plus* the impetus due to gravity because of the height of the crest. On the other hand, from C to A is up the back slope of the crest, and a retardation of the waters occurs. In this manner the water is spread over a larger area as it progresses down stream.

PREVENTION OF FLOODS.—*a.* By Reservoirs: The country about the headwaters of the Mississippi is peculiarly adapted to the construction of reservoirs. Many persons have maintained that the excessive floods in the river may be mitigated by the retention of a considerable portion of the waters of the larger tributaries until a time of lesser flow. But, inasmuch as destructive floods are often dependent on favourable local conditions, as, for instance, the floods of a swollen tributary superimposed on a swollen river, unless the reservoir system is widely extended its appreciable effects will be small. Its extension to an efficient means of preventing floods is chimerical. Starling has recorded ('97, 2-4) that, to reduce the floods of the Mississippi 1 foot for 2 months, 13 reservoirs, each 110 feet deep and 7 square miles in area, would be necessary.

*b.* By Outlets: Another scheme to retard the height of floods is to provide more outlets for drainage. Considerable uncertainty prevails among the engineers as to why the outlet plan cannot be recommended, but they are united in the belief that no relief from flooded conditions can be looked for from them. No single outlet could suffice, and the Lake Borgne outlet, so urgently advised at one time—if the water could be induced to flow into the lake—would soon be shoaled by sediment. It has been shown that disastrous floods do not occur in the lower reaches, so the only effect an outlet would have that might be valuable would be to accelerate the velocity of the river, and thus decrease the time of water above

the danger line. Outlets, where they are needed between Cairo and Vicksburg, might be of great utility; however, the relief of the river at the expense of flooding the back swamps and bottoms destroys the purpose of levees. Crevasses occur as natural avenues of relief. The Nita Crevasse of 1897 discharged 30 per cent. of the entire waters of the river, but fifty miles above the break the height of the flood was not visibly affected.

c. By Diversion of Tributaries: No such works are practical except at enormous expense; and even if money was available, the injury to navigation which would surely result would forbid the execution. Furthermore, there is a question concerning the efficiency of the plan. The Po is quoted (Reports, '90, 3,093) as a river on which the opposite plan, addition of tributaries, was tried with good results. In 1600 the Panaro River, almost the equal of the Po, was joined with the latter; and in 1720 the Reno was added to its tributaries. The increased volume of water, and the consequent increased velocity of current, is reported to have caused the Po to deepen and widen its channel, and the liability to overflow was greatly diminished.

d. By Levees: The first levee on the Mississippi was built in 1717, at New Orleans, to protect that city from an overflow. This levee was a mile in length. The mileage of levees to-day is 1,300. The height of the 1717 levee was 4 feet. The average height of the Louisiana levees to-day is 12 to 13 feet, and they were hardly sufficient to hold the 1897 flood. The object of the levees is to confine the water of the river within certain narrow limits, and thus prevent the swamping of the valuable bottom lands on either side of the river. South of Baton Rouge there are 40,000 square miles of made land, of which 36,000 can be reclaimed for cultivation, and be valued at the rate of \$30 per acre at \$690,000,000. The restraining of the river from spreading over the alluvial plain and banking it within narrow limits must place the surface of the floods at higher and higher levels. While a local 4-foot levee sufficed in a river otherwise free to spread, a much-leveed river breaks over a 12-foot levee. The continual increase of the height of the levees is necessary, not because of greater floods, but because of the closer confinement of the waters. Figures of the heights of levees often show a great increase over the former ones, but in many cases the increase is due to the position on the flood-plain. The caving away of the high alluvial banks has forced the building of levees on the ground of the back slope of the flood-plain. Where a levee 5 feet high met the

d demands in 1874, now a 17-foot levee is needed; the top of the levee, however, is not much higher than before, while the bottom is 10 feet lower.

There has been assigned for the continual increase in levee height another cause—*i.e.*, the rise of the river bed. Investigations on the Po, the Rhine, and the Mississippi show that the bed is scoured out if anything happens during the increasing height. The extreme low-water surface of the Po increased 1.50 of a foot per year, and the measurements are doubted, while the low-water surface of the Rhine and the Mississippi appears to have fallen. In any circumstance little change is apparent. Another objection to levees is that the prolongation of the delta by deposition of sediment will cause an ultimate rise of bed and a future necessary increase in the height of levees. This objection has been answered by calculations which show that in one hundred years the flood height at New Orleans will rise an inch from this cause.

The location of levees is a serious problem. In the eight years subsequent to 1866, 107.5 miles out of 800 miles of levee caved in, in the State of Mississippi. The immediate banks are not, in general, a safe foundation, as undercutting is possible. The levees must always present to the flood a smooth front, sharp salients being avoided. Where caving is excessive, a double system of embankments is recommended. The causes of the breaks in levees include:

*a.* Insufficiency in height. The criterion for height has been the highest known water-mark. The increased construction, as has been shown, demands higher and higher levees. Crevasses have been common occurrences; and as the efficiency of levees increases and crevasses become less the rule, the standard height will be attained.

*b.* The stirring of a full river into action by winds. The March floods, accompanied by high and persistent winds, are much dreaded.

*c.* Unsoundness or faulty construction. Here may be placed insecure or treacherous foundations and injudicious cross-sections.

*d.* Maliciousness. There have been recorded—strange to say—breaks that result from a desire for revenge, because of a private hostility against a wealthy planter. Again, landowners, under the threatening break and destruction of their own property, have relieved the strain by opening the levees on the opposite bank. The swamper, who in the dry season cut timber for the market, and who have depended on the overflow to raft their logs, have

claimed that the levees were injurious to their business. Breaks have been attributed to these men.

*c. Burrowing of animals.*

The increasing efficiency of levees is attested by the following table:

In 1882, 284 crevasses occurred, aggregating 59.09 miles.

In 1883, 224 crevasses occurred, aggregating 34.1 miles.

In 1884, 204 crevasses occurred, aggregating 10.64 miles.

In 1890, 23 crevasses occurred, aggregating 4.25 miles.

The flood of 1890, which was one of great height and duration, was experienced with 80% of the bottoms free from flood. The 1895 flood in Louisiana was so efficiently restrained that 85% of the territory (15,000 square miles, with property valued at \$180,000,000) was protected against complete inundation, and a loss of only 1-6% of the length of the levees was recorded.

**LOW-WATER STAGES.**—The following table (Humphreys and Abbot, '61, 122) gives a comparison between the average high-water dimensions and the average low-water dimensions of the river:

LOCALITY.	SECTIONAL AREA.	WIDTH.	MAXIMUM DEPTH.
<b>HIGH WATER.</b>			
Ohio to Arkansas River.....	191,000 square feet.	4,470 feet.	87 feet.
Arkansas to Red River.....	199,000 square feet.	4,080 feet.	96 feet.
Red to Bayou La Fourche....	200,000 square feet.	3,000 feet.	113 feet.
Bayou to Head of Passes.....	199,000 square feet.	2,476 feet.	129 feet.
<b>LOW WATER.</b>			
Ohio to Arkansas River.....	45,000 square feet.	3,400 feet.	49 feet.
Arkansas to Red River.....	54,000 square feet.	3,060 feet.	56 feet.
Red to Bayou La Fourche....	100,000 square feet.	2,750 feet.	78 feet.
Bayou to Head of Passes.....	163,000 square feet.	2,250 feet.	114 feet.

Below the Red River there is the least range between the two stages of the river, and sixty-six sections give as the ratio between the high-water and low-water widths 0.91. Above the Red River the variations between the high and low water widths do not vary so regularly, but one hundred and thirty-eight equidistant measurements on the river, from the Ohio to the Red River, yield a ratio of 0.74. The table, however, does not adequately express low-water conditions. As far as navigability is concerned, that is measured, not by the average low-water dimensions of the river, but by the

extreme low-water dimensions. The high-water stage is the ruling condition when the bed is shaped and defined. Great masses of sand are carried by the swollen stream and deposited as bars in the channel. The approach towards low water finds these bars a menace to navigation. Back of the bars the water is ponded, and the river bottom presents a series of pools and shoals. As the fall of the water continues, the ponded water breaks through the bars and forms the low-water channel. The formation of this channel, fitted for navigation, depends upon the rate of decline from a high to a low stage. A slow, gradual decline is beneficial. Anything that will reduce the rapidity of the fall from the higher stages is, therefore, desirable, and in this line reservoirs may find a place. Were it not for the magnitude of the task, reservoirs might be constructed to the advantage of the low-water stage in two ways. By slightly reducing high water—always considering the difficulty of knowing what fall of rain to hold in the reservoir—it would lessen the shoaling of the river, and, during the fall of the water, by judicious feeding, a steadiness of volume could be maintained in the river. Lakes and swamps act continually as reservoirs to lessen floods and also to increase the low-water discharge. The argument that drainage and reclamation of swamps and wet lands affect the river flow can find some justification in the consideration of the low-water discharge—that as the natural reservoirs are removed the low-water discharge will diminish and the low-water channel will not be cut out sufficiently to insure a continuous passage. Against all this the main river finds some protection in the extent of its basin and the number of its tributaries. Poor low-water channels are generally found with excessive low-water widths, and a cure for this has been proposed by the Commission by contracting the low-water width to about 3,000 feet. This contraction must result from works in the bed of the river, and not from levees on top of its banks out of contact with the low-water river.

**RIVER CORRECTION.**—German engineers have advocated and put in execution the plan of river correction in order to solve the problem of a large meandering stream. The Rhine, from Strassburg to Mainz, has been corrected, and is to-day a stream flowing along curves of a large radius, sharp enough to give the river a swinging habit, but not so sharp that the tendency to scour the banks is unmanageable. It is strange that no strong effort of this nature has been seriously advocated by the Mississippi River Commission. The problem demands careful preparation, and should be approached

in accordance with correct hydrotechnic principles. In the testimony before the Senate (The Mississippi River Floods, '98, 296-9, Plate 20) a single witness urged the correction of the Mississippi in preference to all other methods, but the map showing the location of the proposed channel was, on the face of it, so irrational as to make the witness's advocacy of the plan of little worth. The natural shape, conditions, and tendencies of the river should be conserved to the greatest extent consistent with the requirements of commerce. The entire energy of the engineers seems to be centred on the completion of the levee system. It is impossible, with the sharp bends in the river, to prevent caving. It can hardly be expected that the levees will serve their purpose effectively so long as bends similar to the Greenville meanders menace any construction.

NEW BEDFORD, MASS., 1902.

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## VARIETIES OF TIDES.

BY

ALEXANDER BROWNLIE.

### THE RED SEA VARIETY.

In the consideration of our subject thus far, the frequent failure of flood-tide forms the distinctive feature in each case, but in the case of the Red Sea it is not so. At Aden, the standard port for reference for the Red Sea, the prevailing type is semi-diurnal; but there are a number of days throughout the year in which only one high water occurs, and an occasional day in which there are none. This variety also differs from all the others in respect to its environment, for it is furnished with only one line of communication with the ocean, the Strait Bab-el-Mandeb. This strait is  $13\frac{1}{2}$  miles wide, but in it lies Perim Island; the wider channel is 10 miles wide, and the sounding line shows that it is close upon 200 fathoms in depth.

Through this deep but comparatively small channel all the power is transmitted which operates tide in a sea fully 1,200 miles long by 200 in the widest part. At Perim Island the mean rise is 5 feet 3, and the highest waters range fully 2 feet higher. At Suakin (in the widest region) the mean is only 1 foot 3, and extremely uncertain tides both in time-intervals and height of rise prevail all through the wide region; but in the Gulf of Suez, at Suez, they range from 4 to 7 feet. This gulf has a length of 170 miles, with an average width of 30.

So the Red Sea possesses a very large region of small tides in the centre and small regions of comparatively high tides at either end. Although the opening at Perim is so small, yet the tidal energy is so great after passing the centre that floods are forced up as high at Suez as at the opening. This fact seems to be accounted for by the straight course of the sea, in which there is no barrier to deflect and weaken the direct force of the pressure; but it is not so with the Gulf of Akabah, for that gulf is not only barred at the entrance, but it lies at a considerable angle off the line of pressure; hence in it the floods are fully 2 feet lower than at Suez.

At Aden the time-intervals range as wide apart as 9 hours to 16

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\* Concluded from BULLETIN No. 5, 1902.

from one high water to another. According to the forecasts for this port, the rise at times is as high, and even higher, at the quarters than at the new moon or full. For example:

DATE.	PHASES OF MOON.	PREDICTED RISE OF TIDE.
Jan., 1900....	Full .....	6 feet 5
" " .....	1st Quarter.....	6 " 7
June, " .....	3d Quarter .....	6 " 7
" " .....	New .....	6 " 7
July, " .....	Full .....	6 " 8
" " .....	3d Quarter .....	6 " 9
" " .....	New .....	6 " 4
Aug., " .....	3d Quarter .....	6 " 6
" " .....	New .....	6 " 6
Dec., " .....	New .....	6 " 8
" " .....	1st Quarter.....	6 " 8

According to the science of the tides, if the moon can raise the floods at Aden 6 feet in height at new moon or full, then at the quarters it ought to raise them 2 feet only; and according to the U. S. Tables for 1902 for Aden in January, February, June, August, September, and December tides are predicted to rise as high as at new moon or full from five to nine days *before* or *after* new moon or full. Now, this is also contrary to the fundamental laws of the lunar science.

With regard to that most striking feature in all variation—days in which flood-tide fails to rise—Mr. Darwin says:\* The Royal Engineers made a series of predictions for Aden covering some two months, then they followed that up by an observation of their forecasts, which resulted in the discovery that one predicted flood failed to appear.

The forecast being made and recorded, of course there was no failure there.

The failure lay with the sea itself; it did not rise at the time the engineers predicted that it would rise.

Possibly this occasional failure may throw a new light upon a very old subject—the celebrated historical incident connected with the escape of Israel from the bondage of Egypt; for it is quite within the range not only of the possible but of the actual that the freaks of this variety were known by the leader of Israel, for he had

\* The Tides, p. 245.

spent forty years of his life in Egypt and forty years in the desert over against Egypt.

Was he not learned in all the wisdom of the Egyptians? The historian of the times tells us that the march at first was not directed in a bee-line to the desert of Sinai, but along the border of the sea, and on the Egyptian side of it, into what seemed a natural trap, where, seemingly, it would be easy work to capture them, when, lo! at the dread moment, when capture was nigh, one of the floods failed to appear, and with the opportune moment came the order to change the march from south to *east*. It was a night march. But did Israel march dry-shod across the sea? Nay, across a dry shoal, which the Egyptians also essayed to do, when, lo! a six or seven foot flood came rolling along, and, in the words of the ancient war song, celebrating the victory,

They sank in the depths like a stone. \*

The historian also gives the important information that at the time of crossing

A strong east wind blew all night and made the dry land. †

In our own times it is even now a matter of fact that the height of floods at Suez is frequently controlled by the wind, and the greatest difficulty to modern navigation arises from the prevailing northeast wind.

It is also a matter of observation that floods flow from the sea into the canal for about seven hours, while ebbs flow out for about five. The modern harbours, also (some two miles south of Suez), are separated from that town by "a shoal which is dry at low water." ‡

At an early period in the history of the Red Sea the Gulf of Suez penetrated farther north than at present. The evidence is quite clear that it once covered a series of depressed shallow vales, whose surface was coated with a deposit of salt, which had all the appearance of a covering of snow.

That was previous to the opening of the canal; but by the opening of the canal these former salt vales have been transformed into salt lakes, the largest of which, the Bitter Lakes, extend some twenty-three miles in length.

Such an extension of narrow sea provides a reason for the march *south*—of Israel—at the start, and it also provides a natural way,

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\* Exodus xv.

† Exodus xiv, 21.

‡ Encyclopædia Britannica, Vol. XXII, page 620.

a shoal at ebb tide, to make good their escape; but in unison with these was the natural agent expressly named by the historian:

A strong east wind made the dry land, and the waters were divided.

That is, the shoal divided the waters of the lakes from those of the gulf.

#### DOUBLE TIDES IN THE ENGLISH CHANNEL.

This variety of double tides has long been the subject of scientific speculation in France and Great Britain. With regard to it, Lord Kelvin said \*:

In Portland Harbour, sometimes, the water rises, sinks, seems to think about it, and then rises again. This harbour has a double low water. Southampton has a double high water, and the double high water seems to extend across the Channel, for there is a double high water at Havre Bar. At Southampton the water remains high three hours, then dips a little. It then rises for one and one half to two hours before falling to low water.

The cause of these remarkable tides was no less a riddle to the distinguished lecturer than to his distinguished hearers, for some observers had said that the Isle of Wight was the cause, while others found it in the Strait of Dover. But it was the opinion of the lecturer that the small Isle of Wight could not cause the remarkable disturbances both at Southampton and Havre; and in this reasonable conclusion we agree.

In order to make a reasonable explanation of all the freaks of this variety, we ought to discover the cause in the larger geographical environment of the whole Channel itself, for the smallness of area in the two places named is altogether insufficient to account for the greatness of area affected by the disturbances. The eastern end of the Channel is suddenly contracted from a width of about seventy miles to one of twenty in the Strait of Dover, but between Southampton and Havre the width greatly exceeds seventy miles. Now, the comparatively insignificant area at Dover is absolutely insufficient to account for the disturbances at Southampton and Havre. On the other hand, at the time of flood-tide, in the eastern end of the Channel, the smallness of the Strait is also absolutely insufficient to relieve the pressure; consequently only a small portion of that flood finds an outlet through the Strait, and the great bulk of it flows back to whence it came in the succeeding ebb. And, by the pressure of that returning ebb, we find the solution for some of the details of the problem, but only some, because the balance is explained by the fact that a large area of the eastern end is co-tidal, and we call it the English Channel basin.

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\* Lecture to the British Association at Southampton, 1882.

On the French side of the eastern end flood-tide continues to press onward for about one and one half hours after Havre is supplied, so the co-tidal basin continues to receive that pressure for that length of time after the level has ceased to rise on the English side.

When the ebb from the basin sets westerly, it takes about one and one half hours to return to Havre Bar; consequently that return pressure causes a second rise on the bar. But the second rise is also partly due to the environment of the peninsula west of Havre, for it bars the way of the receding ebb. So this explains the riddle of the double tides at Havre Bar.

Upon the English side the Channel basin remains at the condition of high-water level for the remarkably long period of three hours, and that basin extends from about Southampton to the neighbourhood of Dover. The long duration of high water in the basin is partly explained by the longer duration of supply on the French side; and on that side, be it observed, the supply is also much greater in bulk. For instance:

FRENCH SIDE.	MEAN RISE.	ENGLISH SIDE.	MEAN RISE.
Havre.....	17 feet 3	Southampton.....	9 feet 9
St. Valery en Caux.....	20 " 6	Portsmouth.....	10 " 2
St. Valery sur Somme.....	22 " 0	Newhaven.....	15 " 3
Boulogne.....	19 " 4	Hastings.....	18 " 3
Calais.....	16 " 2	Dover.....	15 " 2

Observe that the rise at the St. Valerys is double that at Southampton, and at Havre it is also considerably higher than that at Portsmouth. The long duration of flood at high-water level in the Channel basin is due not only to the continuous pressure at the French side, but also to the fact that east of the Strait of Dover, in the North Sea, the English Channel flood-tide encounters the pressure of the North Sea flood. The two pressures block and balance one another, and thus form the English Channel basin by keeping it at high level for the long space of three hours; but at the expiry of the three hours the "little dip" of Lord Kelvin occurs, because the pressure of flood in the co-tidal basin is then relaxed, and from its higher level above the level at Portsmouth and Southampton the ebb from the basin in its passage westward has the effect of a second flood, because *it flows from a higher level to a lower*. So in its passage by Southampton it causes a second rise there; but when the passage is effected, then occurs the fall to low-water level, and that explains the riddle so far as Southampton is concerned. By the time the ebb arrives at Portland harbour it is the time of first low water there,

and the pressure is still sufficiently strong to keep local sea-level steady for a while; but when that pressure is relaxed, then the water falls to the second low level. And that explains his Lordship's riddle in full; and, so far as we know, for the first time.

The principle of geographical environment, whether applied to small seas or great, ought to give a reasonable explanation of all tidal variation; whereas "the power of mathematics," the specific solvent of lunar science, "fails totally in the attempt to express the transmission of tide waves."\* "The irregular distribution of land and water and the variable depth of the ocean produce an irregularity in the oscillations of the sea of such complexity that the rigorous solution of the problem is beyond the power of analysis."† Now, why should mathematical analysis be considered the only method to be used in finding out a problem in geography?

Men usually unravel such problems by *sight*, and not by mathematics! Nobody finds that the oceanic currents are due to the influence of the moon. Why, then, should the action of the tides be considered due to the action of the moon? The answer is, because a wrong method was applied to solve the problem at the first, and that wrong method was begun when no man knew aught of the tides of the world! They also, at first, used a wrong method of looking at the movements of the air. Not so long ago all men believed that changes in the weather were caused by the changes of the moon. There existed a lunar weather science down to about the middle of the nineteenth century. We have since turned from that kind of moon-weather science; and it is merely a question of time when the geographical principle will be accepted as the only right principle to solve every tidal problem instead of the moon-tide solvent, mathematics—an absolutely impotent solvent, and acknowledged to be such by Mr. Darwin himself.‡

In this article we have already called attention to the fact that even the North Pacific Ocean is only one of the varieties. Still more evidence in proof of that remarkable fact is furnished by M. Elisée Reclus. In one of his books he cites the failure of expected flood-tides, which never appeared at all at Petropaulovski.\*\* And in that ocean we have also showed that high and low water take place on the same meridian! ††

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\* Sir Geo. Airy, Johnson's Cyclopædia, Vol. IV, p. 1699, 1st edition.

† Prof. Geo. H. Darwin, Encyclopædia Britannica, Vol. XXIII, p. 355.

‡ The Tides, p. 188.

\*\* New Physical Geography, Vol. 2, page 93.

†† April, 1902, Bulletin Am. Geographical Society, N. Y.

Now, according to the lunar science, neither the failure of floods nor the meridian high and low water ought to be possible in the Pacific Ocean. But the fact of their occurrence in the very ocean where tides are supposed "to be most normal," and to respond more accurately and quickly to the supposed "pull" of attraction, is the impregnable proof of the absolute failure of that science.

And no wonder, for the modern masters of that science—Whewell, Airy, and Darwin—based it upon "an almost total ignorance" of the tidal conditions of the Pacific Ocean.\* Nevertheless, Airy and Whewell removed the seat of lunar attraction from the equator—where it had been placed by the old masters—to the South Pacific Ocean. So, then, the new departure instituted by them is not based upon evidence, but upon an admitted ignorance of the actual tidal conditions at the "cradle of the tides"—the "cradle" from whence globe-travelling waves are supposed to supply flood-tide to all the earth!

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\* *The Tides*, p. 189.

## THE PANAMA CANAL.

BY

GEORGE S. MORISON.

Many other routes have been proposed for isthmian transit, but in every instance, before much actual work has been done, the selection has finally turned to Panama, the successive choice of which by the Panama Railroad Company, by the Congress of Paris, and by the Isthmian Canal Commission confirms its merit.

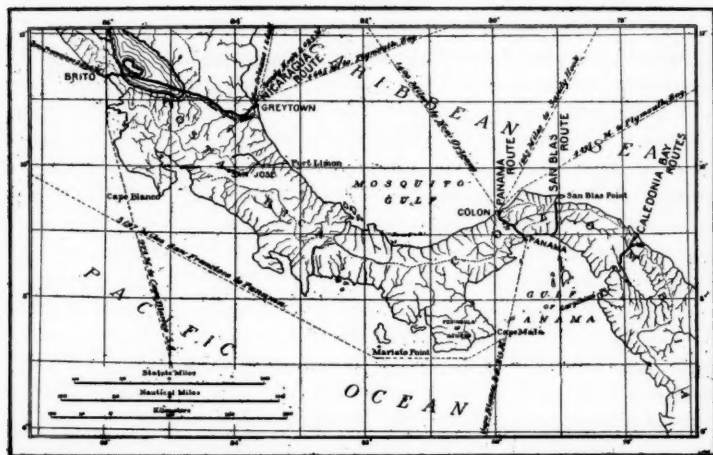


FIG. 1

In no one respect can the Panama route be considered the best. For convenience of access to all ports except those of South America, Tehuantepec is superior, but a summit 700 feet above tide water, too broad to tunnel or to cut through, makes it an impossible canal route. The San Blas route from Mandinga harbor, on the Caribbean side, to the mouth of the Chepo, in Panama Bay, has the best harbors, and is the shortest line between the two oceans; but the summit is four times as high as that at Panama, requiring a tunnel more than four miles long, which is fatal. The Nicaragua route has the lowest summit and the attractive feature of a great inland lake for its water supply. It is a practical route for a canal;

but the distance between the oceans is four times as great as at Panama; it is near the region of maximum volcanic disturbance; there are no existing harbors at either end, and for a distance exceeding the entire width of the isthmus at Panama the Nicaragua Canal must be built through a nearly uninhabited swamp, with a rainfall of over 200 inches a year, where the newly-upturned soil would be full of malaria; and this only brings it to the San Juan River, whose crooked channel must be improved and made navigable. There are three possible routes from Caledonia Bay to San Miguel Bay; the distance between tide water on each of them is about the same as at Panama; there are good harbors at each end; but all of these routes involve tunnels, although on one of them the summit is but little more than 600 feet high, and on another the length of tunnel can be kept within two miles. Various routes have been proposed between the Atrato River and the Pacific, but all of these involve a considerable length of canal in the delta of a great silt-bearing river and a length of inland navigation much greater than on either the Panama, the San Blas, or the Caledonia routes. While not possessing any single feature better than that of some other route, the Panama route has many less bad features than any of the others. It is for this reason that it has been so often selected as the best trans-isthmian line.

The Atlantic terminus of the Panama Canal is at Colon, in latitude  $9^{\circ} 22' N.$  and longitude  $79^{\circ} 55' W.$  The Pacific terminus is Panama Bay, in latitude  $8^{\circ} 55' N.$  and longitude  $79^{\circ} 31' W.$  It is a somewhat singular thing that the course of the canal is from northwest to southeast, and the Pacific end is 28 miles east of the Atlantic end. The length of the canal from shore-line to shore-line is 43 miles, and from the six-fathom contour to the six-fathom contour 49 miles, which distances can be reduced about a mile and a quarter by a change of location which will be mentioned hereafter.

The mean levels of the two oceans are the same. There is, however, an enormous difference in tides, the tide in the Caribbean Sea being hardly more than nominal, seldom amounting to two feet; while the tide in Panama Bay often exceeds 20 feet. If a tide-level canal were built a lock would be required near the Pacific end.

Colon harbor, at the sea end of the Bay of Limon, is a fairly good harbor, which has answered the demands of commerce for fifty years. It is, however, barely 30 feet deep, and is open to the sea on the northwest. When a storm blows in from this direction all shipping must put to sea; but the number of days in a year in which this harbor cannot be used is very small. Panama Bay is

a great body of water with a number of islands in it, generally calm, and with abundant anchorage in protected locations; although a roadstead rather than a harbor, it answers all commercial demands. At low tide the city of Panama is surrounded by mud flats; there is no deep water anywhere near the shore; ships anchor in the bay three or four miles away, and cargoes are brought to the wharves by lighters during high water.

At Panama the actual width of the isthmus from tide water to tide water is only 35 miles in a straight line. The continental divide is about eight miles from the Pacific, and in places less than 300 feet above mean tide. Between this low mountain ridge and the Atlantic lies a hilly country intersected by streams the drainage of which is into the Atlantic through the Chagres River. The Chagres rises in the mountains about 45 miles east of Colon, and enters the Caribbean Sea some miles west of the Atlantic terminus of the canal. The valley of the Chagres, with the low country adjacent to it, forms a natural approach from the Atlantic side. To pass from this valley to the Pacific, it is necessary to go boldly across the low ridge of the Cordilleras. The route selected by the original French company for the Panama Canal is, in a general way, the same as that on which the Panama Railroad was built 30 years before; subject to variations of detail, the routes are practically one, and the only possible route in this part of the isthmus.

The Chagres is a tropical mountain stream, with the excessive variations of discharge which belong to such a river; its maximum flood discharge is approximately 300 times its minimum dry season discharge, which does not differ materially from the extreme range of many rivers in the United States. The area of its total drainage basin, though not completely surveyed, is about 1,200 square miles. It has a comparatively rapid fall, which is greatest near the source; at the point where the canal leaves the Chagres valley to cross the divide the bottom of the Chagres River is about 40 feet above mean tide. The principal difficulties of the northern portion of the canal, from Colon to Obispo, lie in the control of the Chagres River; the principal difficulty of the remainder is the summit cut. In a tide-level canal, such as the original French company proposed to build, these difficulties were virtually all. With the abandonment of the tide-level scheme and the adoption of a summit level reached by locks the problem of water supply for this summit level was added; but as the only source of gravity supply for such summit level is the Chagres River, the problems of the control of this river and of the use of its water to feed the canal become virtually one.

The summit of the divide in the Culebra Cut is less than 9 miles from Panama Bay and only about 12 miles from the six-fathom contour at mean tide in the waters of the Pacific, while it is 35 miles from Colon harbor; although to reach the six-fathom contour a channel must be excavated a mile further. As the summit of the divide marks the limits of the drainage basins, it may be said that three-quarters of the length of the canal is in the valley of the Chagres. This is not strictly true, as Colon itself is outside of the Chagres watershed; but the fringe of country along the ocean is always outside of the watershed of a river, and this is a matter of little real importance. It may be briefly stated that for two-thirds of its length the Panama Canal must follow the lower level of the valley of the Chagres, and that for three-quarters of its length it is within the drainage of the Chagres. The study of the Chagres River is, therefore, the first essential, if one would comprehend the conditions which the builders of the canal must meet.

After leaving the low valley of the Chagres, the canal passes, for eight miles, through a heavy summit cut, commonly known as the Culebra Cut. This cut exceeds in magnitude any excavation ever yet made, although the abnormally heavy work is confined to a single mile. This is the second great problem of the canal.

The failure to appreciate these two conditions in the early days of its work on the canal was one of the causes of the failure of the Lesseps scheme. A proper plan for the control of the Chagres should have been worked out before any large amount of work was done in the valley of the Chagres, and the execution of the work should have been on lines which would have been determined by that plan. The work of excavation should at first have been concentrated on the great Culebra Cut, all the energies of the company being from the start devoted to the expedition of this part of the work, which would necessarily consume a maximum length of time. With such a plan the comparatively easy work in the low country should have been postponed until it was known what would be done with the Chagres and until the time for the completion of the heavy summit work could be measured. Various schemes were proposed for keeping the floods of the Chagres out of the canal, including, among other things, an enormous dam and a tunnel by which the waters would be allowed to escape towards the Pacific without overflowing the dam. These were little more than visionary schemes, which actual conditions proved impossible. Beyond the construction of some parallel diversion channels in the valley of the Chagres, which channels were generally of inadequate size, the original French company did absolutely nothing towards the solu-

tion of the Chagres problem, and comparatively little excavation in the Culebra Cut.

The New Panama Canal Company has done a great deal to determine the real facts about the Chagres River, and has elaborated more than one plan for the control and utilization of that river. It has done no actual work in this way on the ground. It has done work in the Culebra Cut, where it has concentrated its efforts with a view to getting as deep an excavation as possible and showing the character of the material which that cut penetrates. This excavation has all been done with the machinery provided originally by the old company; it has been done in the form of a narrow cut on one side of the great cut, the form of excavation being what they called a cunette, and which leaves the cut in good shape for further work. While the machinery used for this work would not meet the general approval of American contractors, and while many things have been done under difficulties and at greater cost than would otherwise have been necessary, the actual work done in the Culebra Cut by the New Panama Canal Company has really been the most intelligent construction work yet performed on the isthmus either at Panamá or elsewhere.

Besides these two great problems, there are others of lesser difficulty, but equally essential to the completion of the work. Of these, however, comparatively little need be said here. The most important are the locks, the dimensions of which will be somewhat more than those of any lock ever yet built; but they involve no features sufficiently in advance of what has already been done to raise any novel problems.

Apart from the great engineering features mentioned, the real problems which require most study and skill are the control and sanitation of the isthmus. The former will require military organization with the discipline and power which render military occupation effective; the latter will require a thoroughly-trained corps, charged, first, with the duty of eradicating disease, and, second, with the duty of preserving healthy conditions when those have once been obtained. The former will require vigorous action and, perhaps, some violent measures; the latter will require the continual surveillance which often tests character more than the more emphatic earlier issues.

#### CONTROL OF THE CHAGRES.

The Chagres is a tropical stream, subject to the extreme conditions which are found in this part of the world. The boundary of

its drainage basin has never been fully developed. The Isthmian Canal Commission, however, sent a party across from Mandinga harbor to the head waters of the Chagres, which followed the river down to Colon. This work virtually fixed the limit of the valley in one direction. Of the total drainage area of about 1,200 square miles 875 are above the Bohio dam.

The rainfall on this area averages, approximately, 100 inches yearly, which, although high, is not so excessive in the tropics as it would be in a colder climate, and barely half what it is at Nicaragua. The months of least rainfall are February and March, and this dry season sometimes extends well into either January or April, or both. The other eight months form a continuous rainy season, a rainfall exceeding eighteen inches having been observed in every one of these eight months; while rainfalls exceeding twenty inches have been observed in May, August, October, November, and December. During eight months of the year the problem is to dispose of the water of the Chagres; during the other four it is to make sure of enough water for the use of the canal.

The valley of the Chagres may be divided into four sections for purposes of description. The lower section is between its mouth and Bohio, Bohio being the place where it is proposed to build a dam to impound the river through the next section into a lake. The second section is from Bohio to Gamboa, Gamboa being the point where the canal and railroad both leave the Chagres proper to pass through or over the divide. The third section is from Gamboa to Alhajuela, which is the site where it has been proposed to build a second dam and to impound the upper river in a second lake. The fourth is the portion above Alhajuela, and is practically an uninhabited country.

The following table gives the areas of the watershed above the three governing points and the proportional areas and discharges of water.

	SQUARE MILES.	P. C.	PERCENTAGE OF DISCHARGE IN		
			DRY SEASON.	WET SEASON.	ANNUAL.
Alhajuela .....	510	58	75	55	60
Gamboa.....	645	74	83	68	72
Bohio.....	875	100	100	100	100

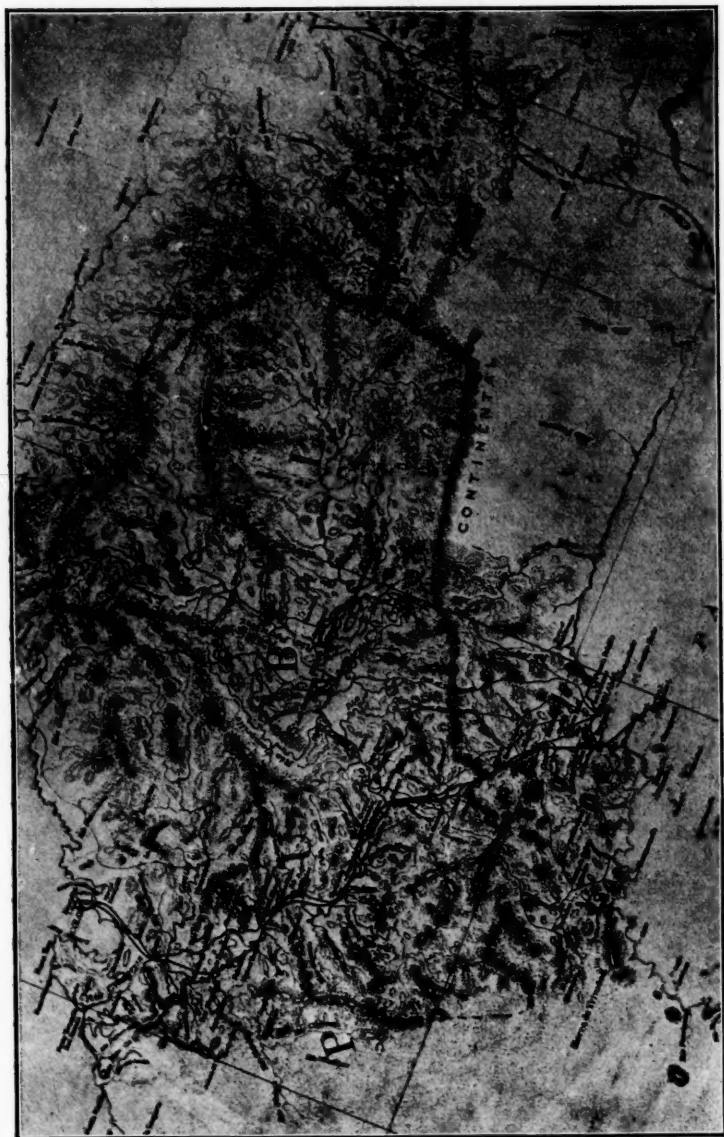


FIG. 2.

This is what occurs in normal conditions of the river as determined from the observations made by the New Panama Canal Company, the calculations being the special work of Gen. Henry L. Abbot, of the Engineer Corps of the United States Army, now retired, and who, as a member of the Comité Technique, was specially charged with this study.

Fifty-eight per cent. of the watershed of the Chagres, including only that above Bohio, is above Alhajuela. In the dry season seventy-five per cent. of the discharge comes from above Alhajuela. This shows that the conditions in the uninhabited mountain country above Alhajuela hold back the water during the wet season, to discharge it during the dry season, so that in the driest season the discharge of the river at Alhajuela is several times the amount of the rainfall above Alhajuela.

The upper Chagres, being that above Alhajuela, is practically a mountain stream; it runs between rocky banks, and is bounded by limestone cliffs. The water is clear, there is no alluvial deposit, and it is a beautiful mountain stream, which, apparently, has all the conditions to furnish a good water supply for the lower country and a good supply of water for the canal or any other purpose. The excellence of its water will probably be preserved while the country is inhabited only by those classes of animals which find their graves inside of other animals. Like all other rivers, it falls more rapidly near its source than below. The rapids are usually over rocks, but sometimes over boulders or very coarse gravel. Below Alhajuela there is more or less silt found in the banks of the river, and the conditions exist there which would make it in some measure a silt-bearing river. This has important significance in connection with the question of controlling the river.

Five great floods have been observed on this river.

DISCHARGE AT	1879		1885		1888		1890		1893	
	c. f.	p. c.	c. f.	p. c.	c. f.	p. c.	c. f.	p. c.	c. f.	p. c.
Gamboa...	78,600	61	64,500	86	58,100	75	65,400	93	43,100	85
Bohio. ....	112,700	100	74,800	100	79,000	100	71,700	100	51,100	100

The greatest of these was that of 1879, which occurred immediately before the visit of M. Lesseps, with his party, to the isthmus. This flood was never measured; it has been calculated.

The three succeeding floods—in 1885, 1888, and 1890—which have been more carefully measured, did not differ very much, and

were generally somewhat less than three-quarters the discharge calculated for the flood of 1879 at Bohio. It is to be observed that the flood of 1890 was very large at Gamboa. This was to be expected. The conditions of the extraordinary flood of 1879 must have been very much the same as those which have produced the extraordinary floods on the Ohio River in the United States—a rainfall distributed over several tributaries in such order that the maximum discharge of each enters the main river when that river is already swollen by the maximum discharges of the tributaries above.

These floods are of exceedingly short duration. They come up quickly, and go down quickly. The maximum discharge lasts only a few minutes. The excessive flood is seldom more than two days, and probably never more than three. Taking the maximum discharge of the Chagres at Bohio at 112,700, the minimum discharge is only about 350—that is, the maximum discharge is 350 times the minimum discharge. Great as this may seem, it is not out of proportion to the floods which we have on many of our American rivers.

The maximum and minimum discharges of the Tallapoosa River in Alabama are not only in the same proportion, but of nearly the same amount as the Chagres. In the Susquehanna, below Harrisburg, a maximum discharge of 750,000 cubic feet per second occurred in 1889, at the same time with the flood on the Cone-maugh which destroyed Johnstown. The minimum discharge is probably not over 2,000 feet per second.

In one respect, however, the Chagres differs materially from these American rivers. The Tallapoosa, with a drainage area of about 3,000 square miles, produces the same results which the Chagres gets from a drainage area of less than nine hundred. The flood discharge of the Chagres, taken at Bohio, in the flood of 1879, was 129 cubic feet per second for every square mile of watershed; which is tremendous. This flood, if continuing for twenty-four hours, would correspond to a run-off of four and three-quarter inches of rain, all running off at the same time. Great floods, derived from a limited watershed, have given the Chagres its reputation; it is a little river, of small drainage area, with the floods of a big river. This, however, does not increase the difficulties of control. If you have to provide for 100,000 cubic feet per second, it makes no difference whether it comes from a thousand square miles or ten thousand square miles. The methods of control are the same.

There are three methods of controlling floods. One is by storage reservoirs. We have already one of nature's reservoirs on the upper Chagres, in the forests, and the general character of the soil. Another is by separate diversion channels. The third is by making the channel of the river itself, or of the canal, adequate to carry them off. All of these methods have been suggested.

Three reservoir schemes have been proposed. One would be formed by a dam at Alhajuela, which is an excellent place to build a dam; with rock banks and bottom, a masonry dam could be built here which would impound an immense supply of water, and practically reduce the amount to be taken care of in the lower river to the discharge of the lower basin. Another scheme was to build a dam for the same purpose at Gamboa—which would have been an excellent scheme if conditions had admitted of building a dam; unfortunately, no bottom could be found. The third proposition was to build a dam at Bohio; the Bohio dam would make the great Bohio lake, which is the solution of the Panama Canal question.

Separate diversion channels are objectionable. The canal must generally be in the lowest part of the valley. If the valley is broad, diversion channels are practicable. At Panama they are practicable below Bohio; they are not practicable above.

The third method, making the main canal big enough to carry off the floods, would require a canal with a bottom width of 400 feet. Such a canal would have the advantage of a very liberal waterway during ordinary stages. It might become silted up a little during the floods, but this could be removed easily by modern dredges; and the value of the additional waterway would more than balance the dredging expense. The writer considers this the only feasible way of carrying off the flood discharge if a tide-level canal is built.

The tide-level canal with this broad channel was estimated on by the Isthmian Canal Commission. In the writer's judgment, it would be the best canal when built; but it would take at least ten years longer to build than the canal with a higher level, and that additional time is fatal to the scheme.

The tide-level canal being set aside, the alternative is a canal with a summit level reached by locks, in which the great depth of the Culebra Cut can be reduced, and some other method than a broad channel found for the control of the Chagres. Such a high-level canal was proposed by Commander Lull, U. S. N., as early as 1875; his plan proposed to keep the canal everywhere well above the level of the Chagres, crossing the river on an aqueduct near Gamboa. Another high-level scheme was proposed in the latter

days of the work of the Lesseps Company, although accepted by him only as a temporary measure. The New Panama Canal Company adopted a high-level scheme, in which a dam at Bohio converts the river above into a lake with the surface about 60 feet above tide water; from this lake the canal rises by two locks to a level 60 feet higher through the great Culebra Cut; this summit level is above the level of the Chagres, and was to be supplied with water through a complicated feeder from a second lake above the Alhajuela dam. After passing through the great cut, it descended, by a single lock at Paraiso, to a short level, thence by a flight of two locks at Pedro Miguel to a third level, and finally by a fourth lock at Miraflores to the level of the Pacific. While this plan was adopted by the New Panama Canal Company, it was manifest that the selection was based principally on the time required for construction, and that a plan, in which the level of Lake Bohio was carried through the Culebra Cut and the higher level with its complicated feeder avoided, would have been preferred if it could have been built in the same time. The plan adopted by the New Panama Canal Company required a flight of two locks at Bohio to ascend to the level of the lake, and a second flight of two locks at Obispo to ascend to the summit level, and four locks to descend from the summit level to the Pacific, of which two were grouped in a flight at Pedro Miguel, thus making eight locks in all.

The Isthmian Canal Commission adopted a plan for a high-level canal differing from that of the New Panama Canal Company in that it raised the level of Lake Bohio from 60 to 85 feet above tide water, carried the level of the lake completely through the Culebra Cut, and dispensed with the second lake above the Alhajuela dam. By using a fixed spillway 2,000 feet long at the head of the Gigante valley, about four miles from the navigated course in the canal, the regulation of the lake was made entirely automatic and the discharge of the Chagres floods kept safely out of the line of the canal below Bohio. This plan requires a flight of two locks at Bohio to ascend to the lake, a flight of two locks descending at Pedro Miguel, and a single lock at Miraflores, making five locks in all.

The Commission's plan followed the same location as the French plan; but a modified route has been suggested, which will follow more closely the location of the Panama Railroad, shortening the distance by a mile and a quarter, on which route it would probably be expedient to use an intermediate level and place an additional lock at Tiger Hill.

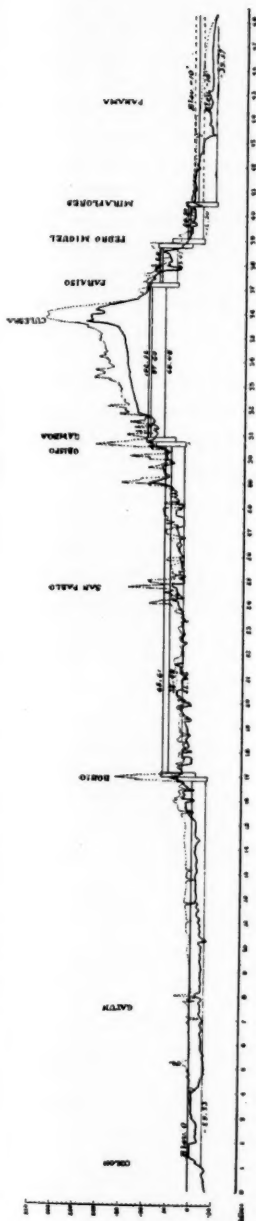


FIG. 3.—PROFILE.

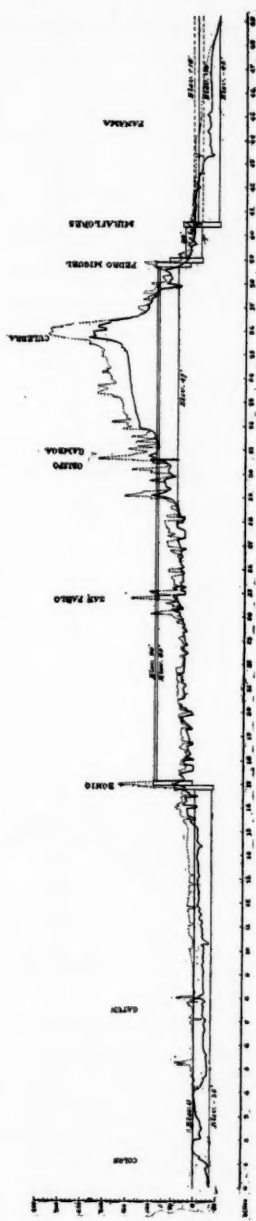
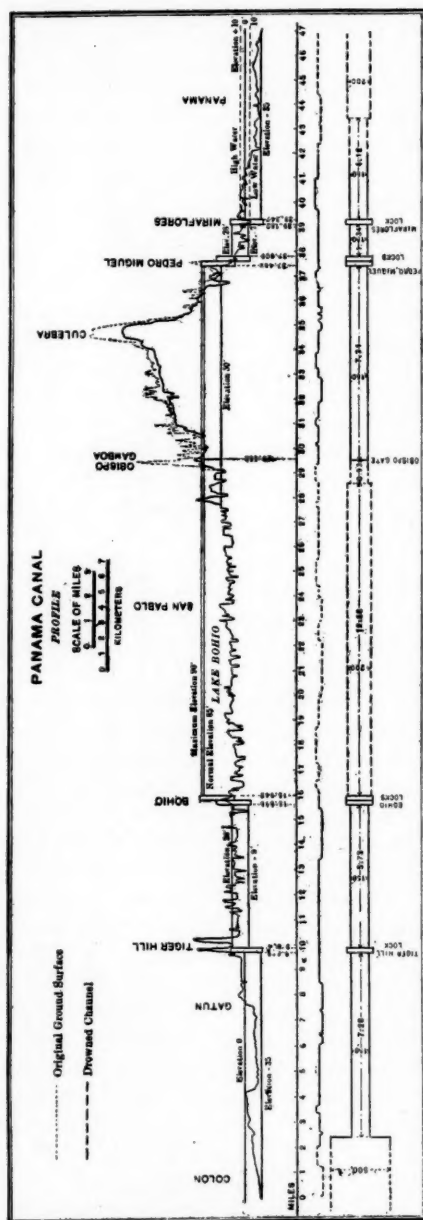


FIG. 5.—TIGER HILL LINE.



In either of the two last plans Lake Bohio is the method of controlling the floods. It has an area of 40 square miles. When a great flood comes down the river the lake will begin to rise slowly, and by the time it has risen five feet will have reached its maximum, and the discharge over the spillway, three or four miles from the navigated course, will be taken away beyond the lower level of the canal. The lake is of such size that no flood will ever create a current in it exceeding that in the Detroit River, which is perhaps the best example of a North American navigable river. During all ordinary conditions the lake will simply have enough current to keep the water in it sweet. The dam and spillway are as complete a solution of the much-decried problem of the control of the Chagres as has ever been found for any great hydraulic question.

The water for the canal must come from the Chagres River,

and during the low water season the supply is inadequate. About 1,000 cubic feet per second are required for the use of this canal, for evaporation and for other losses. The least discharge of the Chagres is about one-third of this; but this is a very rare occurrence. The entire deficiency between two seasons of high water has never exceeded 3,000,000,000 cubic feet, and this would be supplied by drawing down the level of the lake three feet. There are other methods of supply. One is the second lake above the Alhajuela dam. Another is the old Yankee device of flashboards, by which the lake could be maintained three feet above its normal level, the flashboards going out in extreme floods. In the writer's judgment, no provision should be made for low water until the canal is open for traffic. This would mean running the risk of having less than 35 feet of water in the summit level in extreme dry seasons. Flashboards could be used, if necessary, and if the deficiency was found troublesome, the Alhajuela dam could be built, after the canal was open to traffic, better than before.

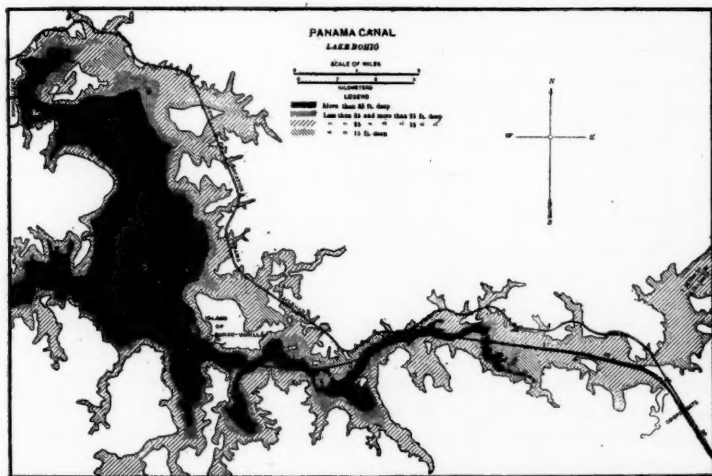


FIG. 6.

Lake Bohio is in itself an adjunct of great value. It is an interior harbor and an anchorage. It is absolutely land-locked, and the deep water runs into side valleys, where ships could be concealed. It will be a beautiful body of water, and in it will be an island of about 400 acres, which I have proposed to call the Island of Bunau-Varilla, in honor of the brilliant Frenchman who has

never despaired of the completion of the Panama Canal, and to whose untiring energy we owe much.

#### CULEBRA CUT.

The Culebra Cut, meaning thereby the whole summit cut, is 7.9 miles long, with a maximum depth of 280 feet, and, according to the plans of the Isthmian Canal Commission, would have a bottom width of 150 feet and a depth of 35 feet below low water. The material is an indurated clay, which has a stratified formation, but which is not rock, although nearly as expensive to excavate as soft

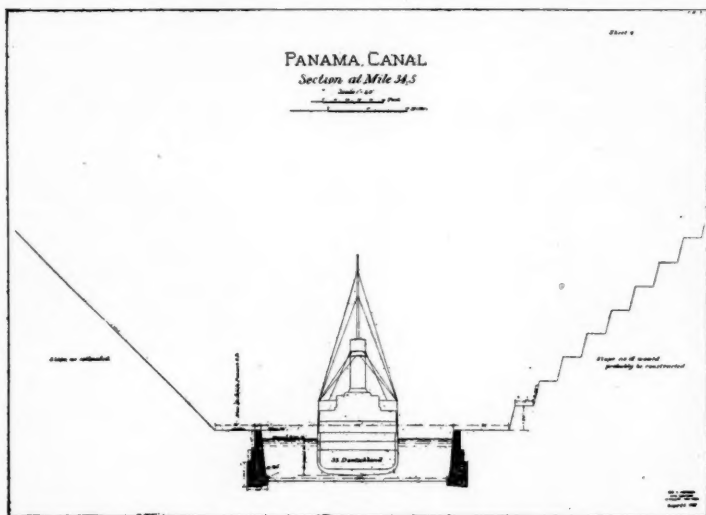


FIG. 7.

rock. There are in it some strata of hard rock and occasional dikes. It would have to be loosened by powder and given a flatter slope than rock usually requires. This cut will be the largest single excavation ever made. It will contain about 42,000,000 cubic yards of excavation. This sounds enormous, but it is only twelve times the volume of the great Pyramid; and if we of the twentieth century cannot handle twelve times as much earth or stone as the people who lived 6,000 years ago laid up in masonry, what are we to think of our modern civilization?

It is thought necessary to line both sides of the cut below water, and the best form of protection seems to be by two heavy masonry walls with nearly vertical faces, so that there will be no danger of

ships striking them, and which will afford benches above, on one of which the track of the Panama Railroad can be laid, and which will catch any material which may slide down from the slopes of the cutting before it reaches the canal. The sides would probably be taken out in a series of benches connected by comparatively steep slopes, but the estimate has been based on an equivalent slope of one on one.

The locks proposed would have a greater capacity than locks that have ever been built for any work. They are to have a clear length of 750 feet and a clear width of 84 feet, with 35 feet of water at all stages over the mitre sills. The plans provide for duplicate locks everywhere.

The Isthmian Canal Commission's estimate was \$144,000,000 to complete the work from its present condition, besides \$40,000,000 to be paid to the French Company, but including no interest during construction. Great as this amount is, it is much less than a canal of equal capacity can be built for on any other line across the isthmus. Furthermore, with some modifications, which perhaps could be made to advantage, and by deferring the duplication of locks till a later time, the canal could probably be opened for traffic at a cost of \$150,000,000, including the payment to the French Company, although not including interest during construction.

#### TIME OF TRANSIT.

The total distance from the shore end of the enlargement for Colon Harbor to the shore end of the wide channel through the mud flats in Panama Bay is 41 or 42 miles. This is divided into two canals by a lake more than 12 miles long in the middle; 13 or 14 miles of canal navigation, not including locks, lie between Colon Harbor and the Lake; a little more than 14 miles of canal navigation, not including locks, lie between Panama Bay and the lake. It is the navigation of these two canal sections which will regulate the passage across the isthmus. While the speed of steamers through the canal will vary with their size, the time which a ship of mean dimensions would take to pass through these two sections may be estimated as follows, the speed in the canal being taken at five miles per hour:

Colon Harbor to Tiger Hill lock, 7.28 miles.....	1 hour 27 minutes
Tiger Hill lock.....	45 "
Tiger Hill lock to Bohio locks, 5.73 miles.....	1 " 9 "
Bohio double locks.....	1 " 15 "
	<hr/>
	4 " 36 "

Panama Bay to Miraflores lock, 4.15 miles.....	50 minutes
Miraflores lock.....	45 "
Miraflores lock to Pedro Miguel locks, 1.34 miles.....	16 "
Pedro Miguel double locks.....	1 hour 15 "
Pedro Miguel locks to Lake Bohio, 8.84 miles.....	1 " 46 "
	4 " 52 "

This time could be reduced for smaller vessels; it will be exceeded by the largest vessels. It may be said, in a general way, that the time required to pass from either ocean into the interior lake will not be less than four hours, and it should not exceed five hours, except for the very largest class of ships. To these figures should be added the time required to pass through the lake and the time lost in Colon Harbor or Panama Bay. It would, perhaps, be fair to add half an hour for each of these terminals, and an hour and a half for the passage of the lake; this would make the total time required for the passage of the canal from 10.5 to 12.5 hours.

Many steamers would take coal at Colon, and all would have to stop at the entrance port to pay tolls, take pilots, etc. There would be abundant room to tie up vessels in the broad harbor section at the Colon end. There is abundant anchorage in Panama Bay, the distance from the canal entrance to this anchorage being determined by the size of the ship and other considerations. There is ample room for ships to anchor and lie up in Lake Bohio, where they could get fresh water and, if necessary, make slight repairs. It is not probable that either section of canal would be traversed at night, except by the smallest class of vessels and in emergencies. Ships would probably prefer to enter the canal from either end about daylight or soon after noon. Ships entering in the morning would make a daylight passage, meeting in Lake Bohio. Ships entering after noon would spend the night in Lake Bohio and pass out on the following morning, probably proceeding under dispatch orders and meeting the in-bound ships at the locks. The Tiger Hill lock, if used, will be approximately half-way between Colon and Lake Bohio, and the Pedro Miguel locks are approached in about the same length of time from the lake and from Panama Bay.

#### CONDUCT OF WORK.

The Isthmus of Panama has had a bad name for centuries. The climate is not a healthy one. It has been a transit line since the early Spanish occupation, and is inhabited by a mixed population of the lowest type. No systematic sanitary work has ever been undertaken. There is an abundance of excellent water in the

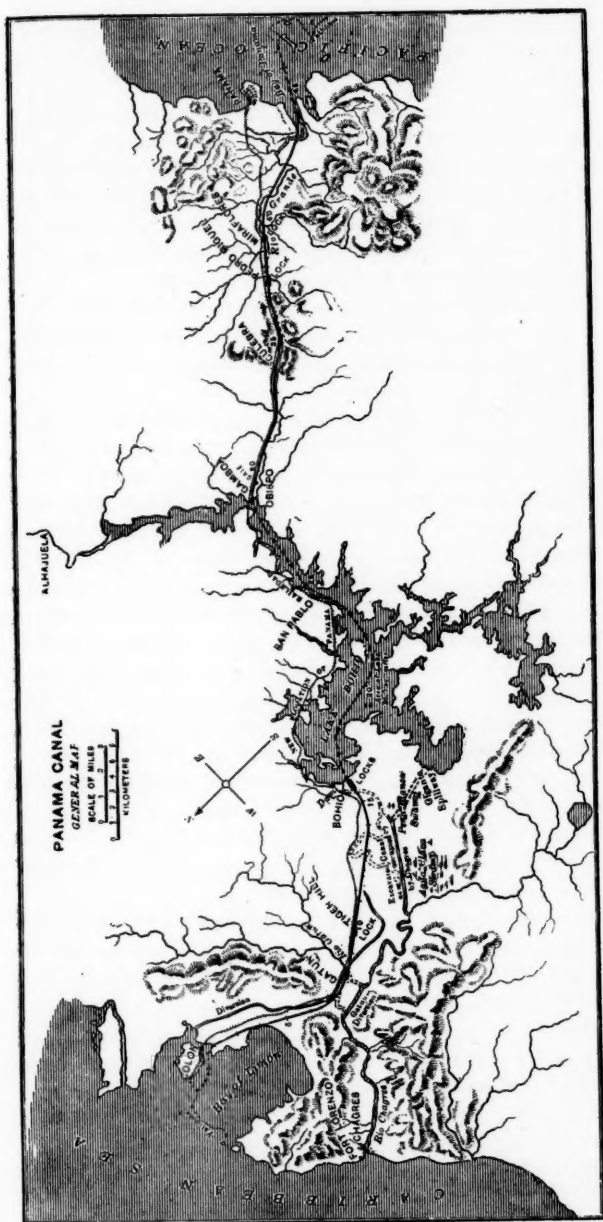


FIG. 8.

mountain streams, but no village or city has a water supply. There is no sewerage. The women wash the soiled clothes in the streams and the people get their water from the same streams. Nearly every vile disease may be found there, and the filth of centuries is kept under some of the houses. It is a tropical country living under the same sanitary conditions which fostered the plague in temperate Europe during the Middle Ages. The death-rate is higher in the dry season than in the wet season, which tells the story of the contamination of the water. The first thing to do is to clean the isthmus, to provide sewers where feasible and sanitary rules everywhere, to furnish the entire line with good drinking water, of which a great abundance may be had at moderate expense, and to compel the employees on the canal to drink nothing else. This will take at least a year.

The plans made by the New Panama Canal Company were unusually complete for preliminary work of this kind; but they were for a canal of different dimensions, with many details which would not be acceptable to American builders. The plans and examination of the Isthmian Canal Commission were made for purposes of estimate and for preliminary work rather than for actual construction. The final working designs remain to be made. Specifications must be prepared, and all the necessary preliminaries which precede the letting of contracts for so great a work must be completed. Both the home and local organizations must be perfected. Much of this work can be done simultaneously with the sanitary preparations, and will take as long. A year spent in preparation before the contracts are let will save time in the end.

After the contracts are awarded the contractors should be allowed another year to perfect their preparations. This is little enough time to provide for the organization of their forces and the purchase and collection of their machinery, much of which will have to be built after the contracts are awarded.

In two years after the transfer of the French property, and the beginning of American occupation, actual construction work should fairly begin. The one greatest single piece of work is the Culebra Cut, and the time required to complete this cut will be the time which it will take to build the canal. All other work should be laid out with reference to this, so that when it is completed there will be no unfinished work to delay the opening of the canal.

The bulk of the laborers must be West Indian negroes, from Jamaica and, perhaps, some other islands. Skilled labor must come from the north, and generally be white. The methods of

work should be so designed that the number of skilled workmen shall be as small as possible, and that they shall be protected from rain and sun when at work. It will probably be expedient to use electric power instead of steam as far as possible. A dam at the site of the Alhajuela dam would furnish the power. If electrical shovels could be used instead of steam shovels, but one skilled man instead of two would be required at each shovel, and the heat from the boiler would be avoided. Although active disease may be exterminated, the debilitating influences of the damp, warm climate will remain, and a system of furloughs must be arranged which will permit the white employ  es to recuperate in northern climates about once a year.

The French companies were private corporations, working with no greater powers than those derived from their concessions. All this will be changed when the work becomes a Government undertaking. The powers of the United States will be those of military occupation, under which sanitary control and discipline can be exercised, which should remove the greatest difficulties which have hitherto beset the Isthmus of Panama. When the work is completed the malarial spots in the interior will have been replaced by Lake Bohio, and the condition of the isthmus should be no worse than that of other damp tropical countries. Lake Bohio, surrounded by hills and mountains, will be a beautiful and accessible body of water, traversed by frequent steamers, with all convenient connections with the ports of other countries. The surrounding hills will add beauty to the landscape and furnish sites for gardens and residences. It is not impossible that this region, which has been regarded as one of the world's pestholes, will in time become a favorite winter resort.

NEW YORK, December 23, 1902.

## CO-OPERATIVE TOPOGRAPHIC SURVEY OF NEW YORK.

Excellent progress was made during the past summer in extending the topographic survey of New York State. The appropriation by the Legislature for this purpose was \$20,000, and the Federal Bureau devoted a like sum to the work, and had immediate charge of it in connection with the general topographic survey of the United States.

During the season just closed mapping was completed of 3,090 square miles, which will be published in fifteen atlas sheets. In addition, primary triangulation for control of future areas was extended over 2,310 square miles. In the course of the topographic mapping careful spirit levels were run for the control of the area surveyed, which aggregated 2,566 linear miles. Dependent on this there were established 103 permanent bench-marks, chiefly bronze or aluminum tablets cemented into masonry structures, and in addition 2,500 temporary bench-marks were established, while the elevations of 8,496 positions were determined. Furthermore, in the course of the mapping 9,006 linear miles of roads were carefully traversed, and their routes exactly indicated upon the maps.

The names of the sheets completely mapped during the past season are derived from the most important villages or cities within their limits, and are as follows, namely:

*In the Adirondacks:* Long Lake, Saranac Lake, Boonville, and Carthage. *In the Catskills:* Hobart and Richmondville. *East of the Hudson:* Copake. *In central New York:* Batavia, Caledonia, Wayland, Coventry, and Greene. *In western New York:* Chautauqua. *On Long Island:* Setauket and Fire Island sheets.

The drafting of these is well under way, and preliminary photolithographic copies of all will soon be available for distribution in a limited number to such persons as may have immediate use for them.

During the past year the engraving division of the United States Geological Survey has published the following New York sheets: Clyde, Weedsport, Geneva, Genoa, Ovid, Palmyra, Phelps, Sodus Bay, Pultneyville, Clayton, Grindstone, Morrisville, Millbrook, Schunemunk, Newburg, Broadalbin, and Saratoga.

The total result of the topographic surveying to date has been the complete and final mapping of 31,106 square miles, or 64 per cent. of the area of the State, which is 49,170 square miles. Pri-

mary triangulation has been extended over unmapped areas aggregating 12,770 square miles. The result of this great survey of the State will be published in an immense topographic map consisting of 264 separate atlas sheets of uniform size. Of these, 132 have been issued, and 44 others are in course of publication.

The drafting on the Boonville sheet of the topographic survey of New York has just been completed, and it represents some unusual topographic features. This sheet depicts the topography of an area of 220 square miles on the western slope of the Adirondacks, in the depression separating them from the elevated plateau land which lies further west and to the north of Rome. The most striking feature of this region is the large number of terraces and broad benchlands which occur at various elevations on either side of the valley of the upper Mohawk River. Their relation to the surrounding country is best stated in connection with an examination of the Carthage sheet, also completed during the past season, and situated northwest of the Boonville sheet and in similar relation to the Adirondacks and the highland to the west thereof. On the former sheet these terraces are best brought out along the valley of the upper Black River.

On the Boonville sheet the lowest notable bench has an elevation of 565 feet, and 60 feet above the broad, alluvial valley which extends from Delta to Northwestern, about 60 miles. This valley will interest engineers who are studying water storage in the State, as it offers possibilities of striking a great storage reservoir and the building of a dam in the narrows two miles below Delta. Such a dam, if erected to the height of 60 feet, would flood an area covering nearly four square miles.

The next terrace is most pronounced immediately west of Delta, with a uniform elevation of 600 feet. Near Westernville are marked terraces with altitudes of 620 and 640 feet. Near Northwestern are a group of terraces and pronounced benches, on the slopes of the hillside, having elevations of 660, 700, 760, 800, 840, and 900 feet. The upland, called to the south of the West Branch of the Mohawk River "Quaker Hill" and to the north thereof "Webster Hill," is comparatively flat-topped, or table-topped. The southernmost table-land has a general summit altitude of 1,280 feet, and the northernmost table-land a general elevation of 1,580 feet.

From the above brief description it is evident that the whole country has been tilted, with the higher elevation toward the north, because corresponding terraces found near the southern portion of the area, and formed probably at the same time, are at much lower

altitudes than the same terraces to the north. All these benches and table-lands tilt with an inclination of about 300 feet in six miles, and these facts will give some interesting food for thought and discussion when the map is critically examined by geologists.

On the eastern portion of this area, that which drains from the Adirondacks toward Mohawk River, the most interesting topographic feature is the manner in which certain brooks have eroded wide channels of uniform slope as they approach with steep descent the valley of the Mohawk. Immediately east of Delta are two streams unnamed which, commencing at an elevation of 900 feet, have eroded channels an eighth of a mile wide, with perfectly smooth, uniform slope to an elevation of 600 feet, after which they pursue their course with varying grades to the Mohawk River. The margins of these wide stream valleys have very steep, bluff slopes, cut with almost knife-like edges straight down to the flat bottom-land. Better examples, even, of this peculiar form of erosion are to be found on the headwaters of Big Brook, above Branchville, and immediately north of Northwestern on Stringer Brook.

A critical examination of the Carthage sheet, drafting on which is still in progress in the office of the United States Geological Survey, gives an idea of the very interesting topographic feature which will be developed in the highland southwest of Carthage and north of Rome when it has been completely mapped. This is a little-known region, and one of which the general maps give an inaccurate conception. Topographically, this region differs radically from the Adirondack country and from the great upland of southern central New York. It is a high, elevated plateau region, covered in large part with a dense growth of timber and largely submerged in swamp. Much of this area was lumbered over in the early days, and is now grown up with second growth, and it is exceedingly inaccessible, the old log roads being tangled with underbrush. The streams of this area abound in trout, and the topographers found the best trout fishing and deer hunting in the State in this area. The northern slopes of this upland, which are shown on the Carthage sheet, have accentuated upon them the terrace and table-land features which were prominently outlined in the upper Mohawk valley near Boonville. The drainage on the Carthage area is northward and eastward toward Black River. The valley of the latter in the neighbourhood of Carthage is broad and level. At Carthage, above the falls, the altitude is 730 feet. This same elevation is maintained for six miles to above the junction of Beaver River. From the map it would appear that a great dam might be built across

the Black River just above the falls below Carthage, with a height of about 50 feet, which would store water over an area of probably twenty square miles, backing the water up to within a few miles of Lowville. Above the Carthage bottom-land and to the southwest thereof up the slope of the highland, the first marked terrace has a height of 812 feet, and is over a mile in width. Immediately above it is a second terrace, with an altitude of 920 feet and about one-half mile in width. Two miles further back is a pronounced terrace, with an altitude of 1,220 feet, which is over two to four miles in width. This terrace holds this uniform altitude for a distance of over twenty miles northwest and southeast. The next high terrace is less pronounced, its summit being more highly eroded, and its altitude about 1,450 feet.

Above this the country slopes with almost uniform rise for six or eight miles to the summit of the upper-land, which has a comparatively uniform elevation of nearly 2,000 feet. An interesting feature of the terraces on the north slope of this highland is that they have a nearly uniform elevation throughout their extent, showing that there has been little inclination in an east and west direction since their formation, the whole inclination having been toward the southwest, as developed in connection with an examination of the Boonville area.

H. M. W.

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## THE CATTLE INDUSTRY IN THE UNITED STATES.

The rise in the price of beef during the autumn of 1901 turned public attention in the United States in a rather sudden way towards the beef cattle industry. Questions began to be asked regarding the future price of beef, and this brought up the whole problem of the numbers of cattle in the United States, the availability of pasture lands, and the relation of supply and demand in the beef market. The so-called "Beef Trust" received a large share of the blame for raising prices, which in reality were partly due to the drought of the summer of 1901, the resulting heavy shipments of cattle to market, and the high price of corn as fodder in the months that followed. One of the clearest and best expositions of the present state of affairs as regards "The American Ox and his Pasture" is found in the *Review of Reviews* (New York) for January,

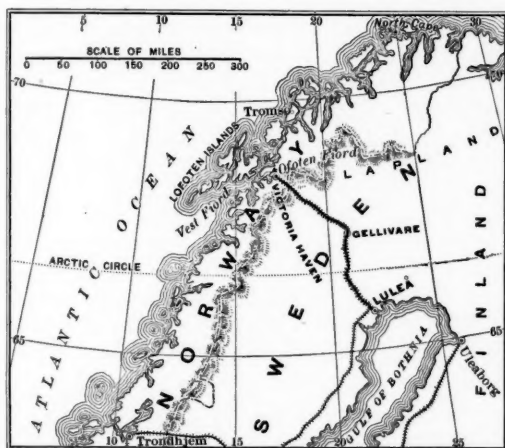
1903, and is by Chancellor E. Benjamin Andrews, of the University of Nebraska. The writer points out that "public pasture is dying out. Areas which half a century ago grew vast herds of buffalo, antelope, and deer, and, subsequently, even more immense troops of cattle, are now almost a waste." This has resulted from the reckless abuse of the range—the pasturing of too many cattle and sheep upon it. Many of the best grasses are annuals, and the reckless feeding of cattle on these leaves little seed for renewal. Thus some of the best grasses have ceased to exist where they were once abundant. During droughts the cattle pull up the grass by the roots. Near streams and springs the grass is trampled down and killed. Thus the cattle have to travel greater and greater distances from their pasture to water. When the grass becomes too poor for cattle, sheep are put in, and they kill the perennial grasses. Vegetable and animal scourges appear. Rabbits, prairie dogs, prickly pears, cactus, and other thorny bushes invade the land. Thus, in various ways it has come about that "extensive plateaus, once rich as gardens of the gods, are now in effect deserts." The cattle business is being forced on to higher-priced land, which makes beef more expensive. The present unfortunate condition of things can be remedied. With smaller herds, kept under supervision; with rotation in the use of pastures; with reseeding in places; by means of wells driven where cattle now have to travel far for water, and in other ways, vast tracts now unprofitable can again be turned into rich pasture lands. Climatic conditions determine, through deficiency of rainfall, that large portions of the United States shall always be better for grazing than for farming, although by means of irrigation, by intensive culture, and by careful selection of crops much of the semi-arid region can be turned into farming country, irrespective of rainfall.

R. DEC. W.

## THE MOST NORTHERN RAILROAD.

This sketch map shows the route of the Ofoten railroad, opened for through traffic in November last between Luleå, on the Gulf of Bothnia, and Victoria Haven, at the head of Ofoten Fiord, on the Atlantic Ocean. The road penetrates about 100 miles north of the Arctic Circle, and is the most northern railroad in the world. Its total length is about 250 miles. The eastern part, between Luleå and the famous iron mines at Gellivare, 44 miles north of the Arctic Circle, has been in operation for over fifteen years. It has now been extended to the Atlantic, to facilitate shipments of iron ore.

Luleå, on a narrow arm of the Baltic, is closed by ice for seven to eight months every year. At Victoria Haven, however, there is not only deep water for the largest vessels, but, like all the Atlantic ports of Norway, it is ice-free the year around, so that ore may be forwarded in every month to the blast furnaces of England and Germany.



THE MOST NORTHERN RAILROAD.

The mines at Gellivare yielded 800,000 tons of ore in 1899, 1,000,000 tons in 1900, and the quantity is expected to be largely augmented, now that there are better facilities for getting the mineral out of the country. These Swedish ores are regarded as among the best steel ores in the world; but they are difficult to reduce on account of the phosphorus in them, and, as Sweden has no coal with which to smelt them, she sells most of the ore to England and Germany.

Mr. L. de Launay, in his paper on Lapland (*Le Tour du Monde*, 1902, Nos. 45, 46), says that 1,800 miners and their families dwell

around the mines of Gellivare; and that further northwest, at Kirunavaara, on the line of the railroad, is a ridge 700 feet in height and several miles long of solid magnetic iron ore, which is estimated to contain over 200,000,000 tons of ore. It is expected soon to begin the development of this source of wealth.

The cost of building the railroad was borne by Sweden and Norway. The engineering difficulties among the mountains in Norway were considerable. The mountains are crossed through the rugged North Valley, in which twenty tunnels, aggregating over two and a half miles, were excavated and several bridges were built, the largest being 591 feet in length and 120 feet above the valley at its highest point.

An ore dock, nearly 1,000 feet in length, and built after the best modern plans with large storage bins, is now being constructed at Victoria Haven. The road will give easy access to the Norbotten (North Bothnia) district of Sweden, which, besides its deposits of iron ore, has considerable agricultural resources that will be developed with the aid of these new transportation facilities.

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## GEOGRAPHICAL RECORD.

### AMERICA.

PLACE NAMES IN THE UNITED STATES.—Bulletin 197 of the United States Geological Survey is a compilation by Mr. Henry Gannett, giving the origin of about 10,000 place names in the United States. It is filled with interesting information as to the various sources from which we have derived our geographical names. We learn that Book Plateau, in Colorado, was so called on account of its shape; Bombay, in Franklin County, N. Y., was named by Mr. Hogan, an early settler, whose wife had lived in Bombay, India; counties in seven States, besides towns and lakes, were named after Daniel Boone; ten counties and towns were named Bolivar, in honour of the military hero of South America; Block Island, R. I., was named for Adrien Block, the Dutch discoverer; Binghamton, N. Y., was named after William Binghamton, of Philadelphia, a benefactor of the town; Golden Gate, Cal., was named by Col. Fremont before the discovery of gold in that region because of the brilliant effect of the setting sun on the cliffs and hills;

Newport News was named after Captain Christopher Newport and Captain Newce; Nyack is an Indian word meaning corner or point; Painted Post, a village of Steuben County, N. Y., was so named because of a painted post erected by Indians over the grave of their chief; Pawtucket is an Indian word meaning "at the little falls"; Quogue is an Indian word meaning clam; Tarrytown is a modification of its former name, Terwen\* (Wheat Town), given on account of its large crops of that cereal; Yonkers was named for a manor house built by the Dutch, the word meaning "Young Lord"; Haverstraw, named by the early Dutch Haverstroo, means oats straw. Of course, the *villes*, *boros*, and *burgs*, with the names of earlier settlers or prominent men, are very numerous. The *Bulletin* is a valuable addition to the nomenclature of the country—a subject not to be treated with authority.

PALEONTOLOGIC AND STRATOGRAPHIC MAP OF THE CANANDAIGUA LAKE REGION.—Dr. John M. Clarke, New York State paleontologist, describes (New York State Museum *Bulletin*, No. 52) an effort to portray on maps, with exactitude and fullness, the paleontologic facts, or, in other words, the actual succession of vital events in the earth's history. He selected the Canandaigua Lake region, which has been studied, perhaps, with more care with reference to the succession of its fossil faunæ than any other equal area in the State. The so-called "geologic maps" of to-day do not attempt to represent anything further than the succession of sediments, or lithologic units. Such a map cannot tell the whole truth, for faunas do not vary *pari passu* with sediments. Thus the vital and organic element of the history of the earth is eliminated from these maps. Dr. Clarke has prepared a map of the two quadrangles known as the Canandaigua and Naples sheets, which afford a rock succession of a vertical thickness of about 3,000 feet, on which he has shown the succession and variation of faunas, or what may be termed a true paleontologic map. It is proposed to issue these maps as companion sheets to the geologic map, and to illustrate by means of them the actual relation of the more important variations in faunas to variations in sedimentation.

TOPOGRAPHIC FORMS IN THE CATSKILLS.—The details of the topographic forms in the western portion of the Catskills are admirably illustrated on the map of the Hobart quadrangle, surveyed during the past season. The area covered by this extends for about

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\* Properly *Tarw*, or *Tarwe*.

eight miles in each direction from Stamford as a centre. Immediately south and east of Stamford the country rises rapidly as a massive upland, sloping quite uniformly to the highest summits, of which Mt. Utsyantha is one of the higher peaks in the Catskills, with an altitude of 3,213 feet. Mt. McGregor, about two miles southeast, has an elevation of 3,253 feet. From the former a fine view is had of all of the surrounding country, as it is quite accessible by good wagon road to the observation tower on the summit. A characteristic of this region is the uniformity of slopes produced by long erosion on rocks of the same formation, the drainage lines being deep sunk in the narrow valleys. The margins of these valleys show numerous little hillocks and benches outlining stream deposits, which occurred when the valley bottoms had higher altitudes than those of the present time. The underlying formations appear to have a general inclination to the southward, as the erosion on the northern slopes of all the valleys has produced much steeper gradients on that side than on the southern.

Another of the high peaks of the Catskills is Blackhead, the altitude of which is 3,937 feet, as shown on the Durham sheet, an old issue of the Geological Survey. Still higher is Hunter Mountain, immediately south of the former, and about ten miles west of Kaaterskill Mountain House, the elevation of this peak being 4,025 feet. Slide Mountain, which is a few miles southwest of Phœnicia, is now definitely proved to be the highest peak in this region, its elevation being 4,204 feet.

H. M. W.

TOPOGRAPHIC SURVEYS IN WESTERN NEW YORK.—An interesting region topographically is that mapped during the past season immediately to the south and west of Rochester, in the neighbourhood of Honeoye Falls, Wayland, Dansville, Geneseo, and Caledonia. This country is on the northern slope of the great central upland, and contains some of the most interesting of the typical smaller Finger Lakes of central New York. The lowland towards Rochester Junction is filled with small hillocks, the morainal deposits from the great glacier which at one time covered the greater portion of New York State. These hillocks are nearly all oval in form, the major axis lying in this neighbourhood almost exactly north and south, thus showing the direction of the movement of the glacier, and having elevations of from 50 to 150 feet above the general elevation of the surrounding country. The positions of old glacial rivers are well outlined, especially immediately

to the north of Honeoye, where Honeoye creek now parallels the Lehigh Valley Railroad, the former course of this stream having been about two miles to the south of its present valley. Another old glacial river is well outlined along the line of the Lehigh Valley Railroad immediately east of Caledonia. To the southward of this low morainal area the country rises rapidly, but with comparatively uniform slope, from an altitude of 660 feet at Honeoye Falls to 2,000 feet on the higher divides separating Hemlock and Conesus Lakes. The highest of all these Finger Lakes is probably Canadice, which has an altitude of 1,092 feet, Hemlock Lake being second with an elevation of 896 feet. Both these lakes, but particularly the latter, are deep sunk in narrow valleys excavated by glacial action, and are bordered by very high ridges, which rise with unusual precipitateness from their margins. Thus less than a mile to the east of the shore of Hemlock Lake is Bald Hill, the summit of which has an elevation of 1,840 feet. At three-fourths of a mile west of Hemlock Lake is the summit of Marrowback Hill, the altitude of which is 1,925 feet. The rise is over 1,000 feet in considerably less than a mile, and these slopes are highly eroded by the numerous steep gulleys which serve as watercourses for the rain which falls on the abrupt hillsides.

H. M. W.

THE LEVEL OF GREAT SALT LAKE.—Mr. L. H. Murdoch, Section Director of the United States Weather Bureau at Salt Lake City, has lately been giving considerable attention to the problem of the level of Great Salt Lake (*Monthly Weather Review*, XXIX, 1901, 22-23; XXX, 1902, 482-485). In the *National Geographic Magazine* for February, Mr. Murdoch points out that the reading of the gauge on Dec. 1, 1902, was 3 ft. 5 in. below the zero of the scale, showing a fall of 11 ft. 7 in. since the close of 1886, the year in which the last rise terminated, and a level between 3 and 4 feet below that of 1847. A wet cycle prevailed at Salt Lake City from 1865 to 1886; while from 1887 to 1902 a dry cycle has prevailed, the average precipitation during the latter period being 1.85 in. below normal. Since 1887 there has been a steady decline in the level. While the amount of water used for irrigation has been increasing, Mr. Murdoch does not believe that irrigation can be charged with more than 3 or 4 feet of the last decline of the lake level, and that while the length of the dry period from 1827 to 1864 was 37 years, he does not think that these recurring periods are of equal length. "A wet cycle like that which began in 1865 may begin next year,

or it may not begin for fifty or more years." The cycles which Mr. Murdoch finds in the Great Salt Lake region seem, on the whole, to fall in with the 35-year period of Brückner.

R. DE C. W.

COLLECTIONS FOR THE NATIONAL MUSEUM.—The Smithsonian Institution is endeavouring to obtain for the National Museum exhibits illustrating the anthropology of the islands recently brought under the jurisdiction of the United States. Comprehensive suggestions as to the collection of such materials have, therefore, been printed as Part Q of *Bulletin* 39 of the National Museum. Army, navy, and civil officials in the islands are the agents through whom it is believed the larger part of the additions to our anthropological treasures will for the present be made.

#### EUROPE.

THE PYRENEES AND THE DISTRIBUTION OF ANIMALS.—Dr. R. F. Scharff, of Dublin, read at the Berlin meeting of the International Congress of Geologists, in 1901, a paper on the influence of the Pyrenees on animal distribution, which has recently been published. He pointed out that ranges running east and west, like the Pyrenees, have a greater influence on animal distribution than others, because they stand in the way of northward or southward movement resulting from climatic changes. The identical species on the two sides of the range may either have taken a circuitous route round its ends or crossed the crest when it was lower or had a still milder climate than at present. He believes that animals, like the chamois, crossed the Pyrenees from the east and spread over the Cantabrian Mountains within comparatively recent times. It is, of course, not surprising that the mountains proved no barrier to such animals; but it is otherwise with reptiles and still lower groups. Many western forms of these crossed into France, no doubt by the lower hills at the extremities of the chain; while eastern forms also made their way into Spain. The movements of amphibia are subject to many difficulties. Among the salamanders *Molge marmorata* and *M. palmata* seem to have been limited within comparatively recent times to Spain and France respectively; but each has now crossed the range, though in small numbers, and seems to have utilized the lower western spurs as a point of crossing. An older form (*Salamandra maculosa*) evidently crossed the crest of the range, and is found at an elevation of 5,900 feet. Dr. Scharff arrives at the conclusion that, though causing some hin-

drance to animal migration, the Pyrenees may easily be turned at their extremities, and that the older forms have, as a rule, crossed the crest of the range, probably in some cases before the glacial epoch. (*The Geog. Jour.*, Feb., 1903.)

KITE METEOROLOGY OF THE WEST COAST OF SCOTLAND.—During the summer of 1902 Mr. W. H. Dines carried out an investigation of the meteorological conditions of the free air off the west coast of Scotland. Kites were flown every day, excepting Sundays, from the deck of a small steam tug, between July 8 and August 26. No difficulty was experienced in starting, flying, or recovering the kites during any weather. The average height reached was 4,000 ft. It was found, among the results of the work (*Quart. Jour. Roy. Met. Soc.*, XXVIII, 300-301), that the temperature gradient over the sea was considerably less than the average value over the land; that the Ben Nevis temperature was lower than that of the air at the same level some sixty miles to the southwestward, and that, as a rule, the humidity increased up to a level of about a mile, and then decreased. This work is interesting to Americans because the suggestion of flying kites for meteorological purposes from the deck of moving vessels came from Mr. A. Lawrence Rotch, of Blue Hill Observatory.

R. DE C. W.

CLIMATIC CONDITIONS FAVOURABLE TO HEATHER.—According to Dr. Paul Graebner, who has made a special study of the moorland heaths of northwestern Germany ("Die Vegetation der Erde," edited by Engler and Pruden; Vol. V, "Die Heide Norddeutschlands," by Dr. Paul Graebner), the "Heide" area is distinguished from the Steppe region farther east by a moister climate, without long droughts; cooler summers, and less intensely cold winters. In Great Britain, wherever heather and its associates are dominant, similar conditions prevail. The amount of rainfall or of aqueous vapour is considerable and constant; long periods of drought occur rarely; the mean temperature of summer is low; the winter is variable, and ice-bound conditions do not last long.

Although the climatic control of heather is thus emphatic, it does not follow that, given the above conditions, heather must grow. Soil plays a very important part, heather being found characteristically on soils poor in plant food ("The Origin and Development of Heather Moorland," by Dr. W. G. Smith, *Scottish Geographical Magazine*, pp. 587-97, Nov., 1902).

R. DE C. W.

THE KAISER WILHELM CANAL.—While the traffic on the Kaiser Wilhelm Canal is not making rapid development, it is holding its own and slowly increasing. The report on the canal, just issued by the German Government, gives the statistics for the year ending March 31, 1902. The number of vessels of all kinds using the canal increased from 29,045 to 30,161. The tonnage increased from 4,282,094 tons in the previous year to 4,285,301. There was an increased tonnage in Danish, Dutch, and Russian vessels, but a decrease of tonnage in British, German, French, Belgian, Norwegian, and Swedish vessels. Both the receipts and the expenses of the tunnel slightly decreased, the receipts amounting to \$530,755 and the expenses to \$605,705.

#### AFRICA.

GEOGRAPHICAL SURVEYS IN MADAGASCAR.—General Gallieni has an article in *La Géographie* (Vol. VI, No. 5) on the geographical surveys of the island since the French occupancy in 1895, with a chart showing the extent of the triangulations carried on between that year and 1901. All the resources of modern scientific geography have been utilized to produce a good map of the island, nine-tenths of which was still unknown previous to the French occupation. Practically the whole of the island has been surveyed, with the exception of a few small forest areas in the northeast and some thorny deserts in the extreme south. The map, based upon these surveys, supplies a great need of the civil and military administration, which had been much embarrassed by lack of good map material. Only the central plateau had been well mapped. The Jesuit Fathers, among the Hovas, had made numerous astronomical and geodetic observations, which supplied the basis for exact and valuable maps of that region. The maps of other parts of the island, based largely upon native reports, were found by the French to be very erroneous.

RAILROAD IN GERMAN SOUTHWEST AFRICA.—The narrow gauge railroad between Swakopmund and Windhoek, in German Southwest Africa, has been completed. It is 237 miles in length and connects the capital and chief settlement of the colony with the sea coast. The region of mountains and deep valleys, among which Windhoek is situated, is well adapted for agriculture and cattle-raising where irrigation is possible. This is apparently the most valuable part of the colony, and is the district to which the Germans are inviting immigration. The railroad is expected, there-

fore, to be very important in the development of the country. As the region traversed ranges in altitude from sea-level to 5,000 feet, some of the grades are steep, and the passage of the valleys required bridges aggregating 4,600 feet in length. Passenger trains make the journey in two days, spending the night midway at Karibib; freight trains are as yet three to four days on the road.

ACCLIMATIZATION OF THE ENGLISH IN THE UGANDA PROTECTORATE.—In Sir Harry Johnston's book, "The Uganda Protectorate" (London, 1902), the author is very optimistic regarding the future of portions of that country as sanatoria for European colonists. The Nandi plateau, between 7,000 and 10,000 feet in altitude, is "without a single ugly or unfriendly spot. . . . It seems to be awaiting the advent of another race which should make it a wonderland of wealth and comfort, a little England, half a Scotland, or a large Wales, lying exactly under the equator, at an average altitude of 4,000 feet above the Victoria Nyanza." This rosy view of the future colonization of this plateau by British colonists, who shall make their permanent homes and bring up their families there, contradicts the experience of the English in India. In the opinion of a recent reviewer of Sir Harry Johnston's book, "the critic who is familiar with the hill sanatoria of the Himalaya and Nilgiri mountains of India will not be convinced that Nandi is likely to be any better fitted for the permanent occupation of British capitalists and labourers, and their reproduction, than Darjeeling, Mussoorie, and Simla; Ootacamund, Coonor, and Kodaikanal."

R. DE C. W.

#### ASIA.

NAVIGATION ON THE YANGTSE RIVER.—The *Trade Reports* of China for 1901 contain some interesting facts with regard to navigation on the Yangtse. At Hankow, the great tea port on the river, 3,767 vessels, with a total tonnage of 2,678,246, entered and cleared during the year. Twenty-two river steamers run regularly between Hankow and Shanghai, and many ocean-going vessels also visit the port. Two German steamers run regularly between Hankow and Swatow, and eight tea steamships cleared for Odessa with cargoes of tea. Hankow is thus a river seaport, and is the furthest point inland in China to which ocean steamers penetrate. At Ichang, about 1,000 miles up the Yangtse, 348 steamers, with a total tonnage of 305,674, entered and cleared during the year. Many of these vessels are stern-wheel boats. As the number of

steamers increases the junk trade diminishes, though it is still very large. The rapids, which obstruct navigation on the upper Yangtse, begin some distance above Ichang. A few small steam vessels have succeeded in getting through these rapids to Chungking, the great commercial centre of Szechuan; but the general opinion now is that steamers can be practically useful in this stretch of the river only for towing boats between the rapids, and that improved machinery and a better organization of labour must be utilized to get freighters through the most difficult parts of the river.

#### POLAR.

BARON TOLL'S EXPEDITION.—News of Baron Toll's party, received in Russia last fall, contained the surprising information that he was supposed to be on the little-known Bennett Island, north of the New Siberia group; also that his zoologist, Birula, was on New Siberia Island. Toll and the astronomer Seeberg left the winter quarters of their vessel, *Zaria*, on Kotelnoi Island in May last for Bennett Island. Birula and some natives had already started for New Siberia Island. The *Zaria* was instructed to visit these islands for the purpose of carrying the explorers back to camp as soon as the ice conditions permitted the vessel to go north. The *Zaria* left Kotelnoi early in July, but was unable to reach either Bennett or New Siberia Islands on account of the ice pack. Last fall the *Zaria*, with all the other members of the expedition, went south to the mainland, taking up winter quarters at the mouth of the Lena. Lieutenants Matissen and Koltchak, with nine men, returned to St. Petersburg in January, and reported that a relief party was to leave the *Zaria* by sledge for Kotelnoi, in the belief that the three explorers had probably made their way over the ice to that island. No special anxiety as to their fate is yet felt, as they had in view the possibility that the vessel might not reach them, and they might be compelled to winter on the islands which they intended to visit.

THE SPITZBERGEN DEGREE MEASUREMENT.—In 1898 Swedish and Russian expeditions began operations for the measurement of an arc of the meridian, the Swedes occupying the more northern and the Russians the more southern parts of the Spitzbergen group. The work has been spread over five summers, in some of which little was accomplished owing to unfavourable weather conditions. It was completed last summer, when the Swedish expedition returned home after having effected a junction with the Russian net of triangles in the south.

THE GERMAN ANTARCTIC EXPEDITION.—The joint publication of the Berlin Institute for Oceanography and Geography, Part II, announces that the *Gauss* arrived at Kerguelen on January 2, 1902, where it met the land party that had previously reached the headquarters in Observatory Bay with supplies. On January 31 the *Gauss* sailed for her destination in the Antarctic with provisions for nearly three years. Dr. von Drygalski, leader of the expedition, intended, if possible, to land on Heard Island and then make straight for Wilkes's Termination Island, skirting the ice towards the west to take advantage of the prevailing easterly winds and ultimately turning southward and entering the ice. He thought it likely that the *Gauss* might lose some of her gear in the ice, and desired to caution friends at home not to infer that the expedition had met with disaster if pieces of wreckage from his vessel were picked up. He said he might be able to send news home by June, 1903; but, as the expedition is planned for three summers in the ice, no news will be good news till June, 1904.

#### AUSTRALASIA.

GLACIATION IN AUSTRALIA.—Mr. J. P. Thomson, in an address before the Royal Geographical Society of Australasia, Queensland, on September 22, 1902, said:

To my mind, no satisfactory evidence of well-defined traces of glaciation in Australia has yet been brought forward. Drift ice masses may probably have left their imprints on some of the shore rocks of former estuarial channels, but there is nothing to indicate that the whole of the continent was at any time involved in extensive ice-sheets. In point of fact, the past and present fauna and flora denote the occurrence of mild climatic conditions which have prevailed for ages—conditions of climate partaking more of the tropical than the Arctic character.

Mr. Thomson adds, however, that after writing the above the newspapers reported that Mr. A. Gibb, Government Geologist for Western Australia, had reported that on his trip from Cue, the centre of the Murchison goldfield, to Carnarvon, between the heads of the Woramel and Minilya Rivers, he discovered, associated with carboniferous rocks, an extensive deposit of glacial origin. He traced this deposit over sixty or seventy miles. With it were a large number of ice-scratched boulders.

#### GENERAL.

EARTHQUAKE OBSERVATIONS.—In his paper on "Seismological Observations and Earth Physics" (*The Geog. Jour.*, Jan., 1903), Mr. John Milne divides earthquakes into two groups: First, those which

disturb continental areas and frequently disturb the whole world as a whole; and, secondly, local earthquakes, which usually disturb only an area of a few miles' radius, and seldom extend over an area with a radius of 100 and 200 miles. He endeavours to show that the former are the result of sudden accelerations in the process of rock-folding accompanied by faulting and molar displacements of considerable magnitude, while the latter are for the most part settlements and adjustments along the lines of their primary fractures. A long series of observations justified Mr. Milne in saying (1883) that "it is not unlikely that every large earthquake might with proper appliances be recorded at any point on the land surface of the globe." This statement was not fully accepted until six years later, when it was found that the photographic records of the displacements of a horizontal pendulum showed abnormal movements that were traced to earthquakes which had originated at great distances from the observing station. From this time seismologists had before them a new field for research, and stations to record world-disturbing earthquakes are now to be found in very many countries. The most complete organization of stations is that working in co-operation with a committee of the British Association. There are now thirty-eight of these stations scattered all over the world, and their seismological observations are published semi-annually.

**THE BRITISH PACIFIC CABLE.**—The British cable, laid between Vancouver, British Columbia, and Brisbane, Queensland, completed last fall, is the last link in a girdle of British telegraph lines extending around the world. With the exception of two landing-places in Portuguese territory, at Madeira, and at St. Vincent, on the Cape Verde Islands, all the landings are in British territory. The line between Vancouver and the North Island of New Zealand is over 8,000 miles in length. It is extended from New Zealand to Norfolk Island and Brisbane. Between Vancouver and New Zealand the only landing-places are at Fanning Island and the Fiji Islands. The longest stretch of cable between landing-places is from Vancouver to Fanning Island, 3,600 miles. The greatest depth at which the cable was laid was 19,200 feet, the average depth being 16,200 feet. The cable was opened for business about the middle of December, and it is now possible to send a message around the world in thirty minutes. This great undertaking was not carried out without much opposition, particularly on the part of the cable lines between Australia and the Malay Archipelago which connect with Europe.

WEATHER AND TRAIN LOADS.—A recent number of the *Monthly Weather Review* calls attention to the fact that the load which an engine is given to draw is, in many cases, regulated by the weather forecast. Thus, in the case of freight trains leaving Pittsburg for the West and Northwest, there are four classes of train loads, arranged alphabetically, depending upon the kind of weather which is expected. If the report is for favourable weather, the engine's load (A) is 1,750 tons. When there is a reasonably good weather report the locomotive's load is limited to 1,625 tons (B). Worse weather means a load of 1,475 tons (C), and very bad weather reduces the load to 1,225 tons. In the case of stock trains, Class A is 1,450 tons, and for high-class freight running at higher speed than ordinary freight Class A means 1,525 tons per train. The same allowance is made for the three lower classes as noted above.

R. DE C. W.

EFFECT OF DOUBLE WINDOWS ON TEMPERATURE.—H. Dufour has made a study of the effect of double windows in keeping out winter cold (*Arch. Sci. phys. et nat.*, Geneva). He placed one thermometer in the outside air, about 4 inches away from an east window; another was fastened between the two windows,  $1\frac{1}{2}$  inches from the inside window, and the third was in the middle of the room. The space between the windows was  $8\frac{1}{4}$  inches. The results of observations during one winter were as follows:

OUTSIDE.	BETWEEN WINDOWS.	DIFFERENCE.	ROOM.
25.2° calm.....	37.4°	12.2°	56.3°
23° moderate wind.....	35.6°	12.6°	59°
17.6° high wind.....	33.3°	15.7°	57.2°
23° " " .....	38.3°	15.3°	55.4°
30.7° calm.....	41.0°	10.3°	57.2°

The differences were 11–13° in calms, and rose to between 15° and 16° when there was a high wind.

R. DE C. W.

## IMPROVEMENTS TO NAVIGATION IN THE GULF OF ST. LAWRENCE.

BY

LIEUT.-COL. WM. P. ANDERSON,

M. Can. Soc. C.E., Chief Engineer Department of Marine and Fisheries, and  
General Superintendent of Canadian Lighthouses.

Within the past three or four years there has been considerable discussion in the public press respecting deficiencies in aids to navigation in the Gulf of St. Lawrence, prompted by the large number of casualties on this great Canadian route and the consequent high rate of marine insurance. While investigations into past wrecks have demonstrated that the blame lay rather with the culpable ignorance and negligence of sailors and the defective system of pilotage than with aids to navigation, the agitation has had the good effect of inducing Parliament to vote liberal subsidies for the extension and improvement of the lighthouse and fog alarm service.

The lights in the St. Lawrence are not, it is true, strictly first-class, having been built under exceptional conditions. When the Dominion Government was organized in 1867 there were very few aids to navigation of any kind, and the Minister of Marine of that day was confronted with the problem of efficiently lighting one of the longest coast-lines in the world out of a very slender purse. He wisely decided to put up a large number of cheap wooden lighthouses, provided with economical yet fairly effective apparatus, rather than a small number of expensive aids. The result was at that time eminently satisfactory; but with increased speed of steamships, and with the strenuous competition which compels navigation even through the thickest fog, the time has arrived when more quickly-flashing lights and the most powerful fog-signals must replace the aids that gave such good service in the past. It is consequently contemplated to do a great deal of work in improving aids to navigation on this route during the coming season. A first-rate quick-flashing light and powerful fog siren are being built on the northeast end of the island of Belle Isle to mark the gateway to the more northerly entrance to the Gulf. A modern steam lightship is being built to mark the dreaded east end of the island of Anticosti. Cape Rosier light is being increased in power and made occulting. At

Fame Point, the landfall steered for in crossing from Anticosti, a fog alarm was installed last year. This is one of the Hamilton-Foster sirens, which give out different signals to the several cardinal points, and is established on trial, as the principle is yet considered to be in the nature of an experiment. At Matane a first-class siren will be established this year; and at Father Point, which is important as marking the limits of the pilotage ground, a first-class siren has just been installed. These are only some of the changes already made and in contemplation, and are merely quoted as instances of the class of work in which the Government is now engaged. When they are completed, it will be possible, with ordinary good seamanship, to navigate the St. Lawrence safely under any conditions of weather.

The fog alarms now in course of installation are the most powerful of their kind in the world. They are either sirens, or modifications of sirens, of the largest size, operated by compressed air, and will undoubtedly give satisfaction if mariners can be taught that sound signals are always liable to aberration, caused through want of homogeneity in the atmosphere. Lack of knowledge of this physical law is probably the cause of more wrecks than any other single factor in recent marine disasters.

The recent invention of a lamp to burn vaporized petroleum under an incandescent mantle promises to furnish an extremely powerful light at a minimum of care and expense. It is a moderate estimate that coal oil so treated will produce ten times the light that can be got out of it when burnt under ordinary conditions. This petroleum vapour-burner is being adopted for the latest Canadian lighthouse installations.

Last year the system of telegraph lines and cables built and maintained by the Government as aids to navigation was completed by their extension to Belle Isle, the island itself being connected with Labrador both by cable and etheric telegraphy. The whole of the Canadian coast of the Gulf, including the island of Anticosti, is, therefore, in direct telegraphic communication with shipping centres. These lines are operated at a heavy loss expressly for the benefit of shipping. The general adoption of an etheric telegraph system is now under consideration by the Canadian Government.

A comprehensive system of tidal stations has also been established throughout the Gulf and on the Atlantic coast. This enables reliable tide-tables to be issued for the harbours, with which the tidal streams of the St. Lawrence are brought into relation. The currents in the Gulf have been investigated in a general way, and

the work is being continued. The results already obtained prove that there are no currents in the open Gulf much exceeding one knot—a rate practically inappreciable by modern steamers. Much misapprehension formerly existed on this point, which should be removed by the extensive publication of the results. As these have been summarized in all the leading maritime periodicals, ignorance of them by sailors is inexcusable. It is unnecessary to emphasize the importance to the navigator of reliable information of this character.

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#### FOREST RESERVE IN THE SOUTHERN APPALACHIANS.

No more interesting Government report has been issued in many years than that here noticed bearing the title:

Message from the President of the United States, transmitting Report of the Secretary of Agriculture, in relation to the Forests, Rivers and Mountains of the Southern Appalachian Region.

The President's Message is short but emphatic, and the Secretary's Report, going somewhat into detail, is followed by appendices, with full treatment of special themes.

A reserve in this region was first urged upon Congress in 1900, by the Appalachian Mountain Club in New England and by the Appalachian National Park Association of the Southern States, and the sum of \$5,000 was at once appropriated for investigation. The needed field studies were made in 1900 and 1901, and were far more extended than could be provided for by the appropriation, owing to the vigorous co-operation of the United States Geological Survey. The work covered parts of six States.

The Southern Blue Ridge and the Unaka Mountains are described—the highest region in North America that is covered by hardwood forest. The river bottoms and water-powers of the Piedmont Plateau depend on the regularity of the streams rising in these mountains, and such regularity hinges, in turn, upon the preservation of the forests. No glacier has invaded the region, the rainfall is abundant, and the development of the forests has been unimpeded for geological periods, until now 137 species of trees are found there, and a still greater variety of shrubs.

The variation of altitude is great enough to affect the distribution in a marked way: On Mount Mitchell, oak, hickory, maple, and

chestnut grow at the base, followed by hemlock, beech, and birch; while above are spruce and balsam, and higher still are shrubs and dwarfed trees. The humus is often a foot or more in thickness, a formation all-important, easily washed away, and not to be replaced in centuries, if at all. Many slopes have been cleared, cultivated a few years until the soils were run out, and then abandoned.

The lumbermen have sought the rarer woods, or in many places have cut everything that would sell, felling the desired trees without regard to what they would crush, and leaving the waste to propagate destructive forest fires. So far have the ravages gone that it would be too late, after another decade, to save these splendid forests. Not more than 10 per cent. of this mountain land has slopes of less than ten degrees, and yet 24 per cent. of it is already cleared, exposing great areas on hillsides that should have been allowed to keep their protective cover. Grass, forming a strong turf, will not here, as in the cooler climate of New England, bind the soils from washing.

The soils, even of the valley farms, are removed by the floods, and many thousand acres of rich bottom lands were in this way damaged, or ruined, during the year in which the report was written. The forests and the farms, therefore, can only be rescued by setting the region apart as a public reserve. There is also more than a million horse-power of undeveloped water-power available along the streams of this region. The uniformity of flow is in exact ratio to the preservation of the forests, and, where cutting has been excessive, water has often had to be supplanted by steam. It is a question of water storage; and as there was no ice invasion, and as there are no lakes, the humus cover is the sole means of hoarding the waters and doling them out so as to serve the millwheel and save the field.

Being a region of heavy rainfall, floods will be great and enormously destructive. A single storm at the sources of the Catawba River, in May of 1901, ravaged the lower river country for more than 200 miles, and cost the farmers one and a half million of dollars. Another storm in August of the same season did another half million dollars of damage. The May floods of the entire region carried the losses to \$7,000,000, and, adding the other floods of the year, the destruction of property in 1901, in the Southern Appalachians, amounted to \$10,000,000. National reservation is the only means of averting such stupendous calamities, for the States concerned are not able to bear the financial burden; and, moreover, the separate States, as North Carolina, give rise to the streams whose havoc

is mainly wrought in other domains. We cannot expect one commonwealth to tax itself for the benefit of its neighbours. The Federal Government should not delay to act upon the matter; and it is believed that, with good forest management, such a reserve should soon become self-supporting.

Appendix A contains several papers descriptive of the forests and forest conditions, including, also, lumbering, accounts of the forest areas by river basins, and a list of native shrubs; Appendix B, by Arthur Keith, of the Geological Survey, deals with the topography and geology; another supplement is devoted to hydrography, and a fourth to the climate. The Report closes with matters pertinent to immediate action in setting apart a reserve. Here are memorials from several scientific and business associations, a report of the Senate Committee, resolutions and acts by the legislators of Virginia, Tennessee, Georgia, and the Carolinas, and a large number of extracts from the press.

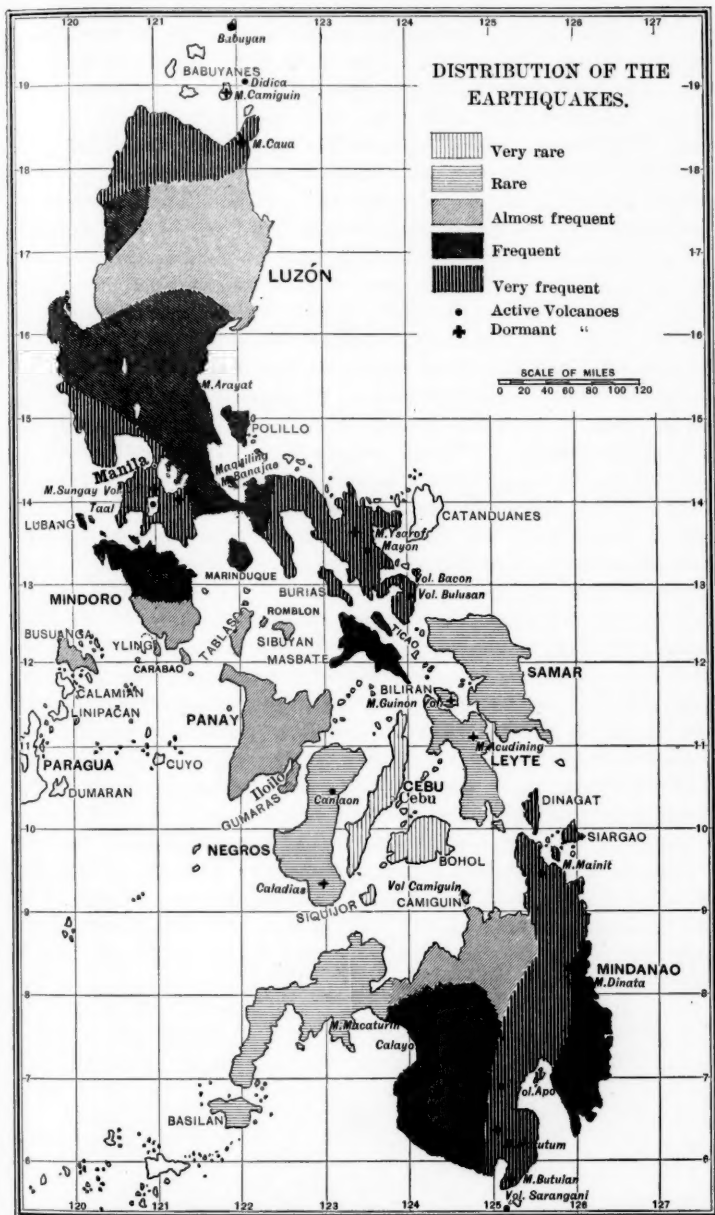
After all, the reader will, perhaps, be most deeply impressed by the rich outfit of illustration, showing forests, typical Appalachian views, and, especially pictures of the havoc wrought on slopes and bottom lands by rainwash and resistless floods.

A. P. B.

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#### EARTHQUAKE AND VOLCANIC CENTRES IN THE PHILIPPINES.

This sketch map, showing the distribution of earthquakes and their relative frequency throughout the Philippines, and also the active and dormant volcanoes in the archipelago, has been compiled from two maps in the report recently prepared in Manila by M. Saderra Masó, S.J., Assistant Director of the Philippine Weather Bureau. The information embodied in the map was collected by the Meteorological Station at Manila, and embraces complete records of seismic phenomena for the past eighteen years. Twelve of the volcanoes here shown are more or less active. They include Babuyan, Camiguin, and Didica, in the Babuyan Islands, north of Luzon; in Luzon, the great volcanoes of Mayon and Taal, besides Bulusan and Bacon; Malaspina, on the island of Negros; Camiguin, on the island of the same name off the north coast of Mindanao; and on Mindanao the volcanoes of Apo, Macaturin, and Calayo.



The most famous Philippine volcano, and one of the finest volcanic cones in the world, is that of Mayon. Its height is 8,970 feet, and the volcano is visible at a great distance. Since 1766 records have been kept of its eruptions. In that year many plantations and villages were buried under a stream of lava which flowed down its eastern slope. About 1,200 lives were lost in the eruption of 1814, which buried the country around a part of the base of Mayon under the outpourings of lava and dust. A similar calamity in 1825 destroyed the lives of about 1,500 persons. In the nineteenth century there were a number of severe eruptions, including one in 1886-87, which continued about nine months; an eruption in 1897 killed 350 persons and destroyed much property. Twenty-two violent eruptions of this volcano are on record.

Next to Mayon, the Taal volcano is the most remarkable. It is on an island in the Lake of Bombon, and the island, built up by its outpourings, has an area of 220 square miles. The volcano is incessantly ejecting dust and vapour from its crater. Taal, as well as Mayon, has been the centre of numerous destructive earthquakes; but no very great eruption has occurred since 1864, when four villages around the mountain were completely destroyed.

Some of the volcanoes are not given to violent outbursts. Apo, in Mindanao, for example, a majestic mountain rising 10,311 feet above the level of the sea, gives evidence of its activity only by numerous solfataras, or jets of sulphurous vapours. Macaturin is not known to have had more than two eruptions since the arrival of the Spaniards in the sixteenth century. Calayo is also in the solfataric stage, sulphurous vapours issuing not only through the crater but also along the steep banks of the neighbouring river. Camiguin has a cone that was formed almost entirely during the eruption of 1871, since which time its activity has gradually abated.

Manila is well situated for experiencing nearly all the earthquake shocks radiating from the different volcanic centres of Luzon. It stands on alluvial soil, which is usually more violently disturbed by earthquakes than the underlying rock, and it is only thirty-five miles north of the active volcano Taal.

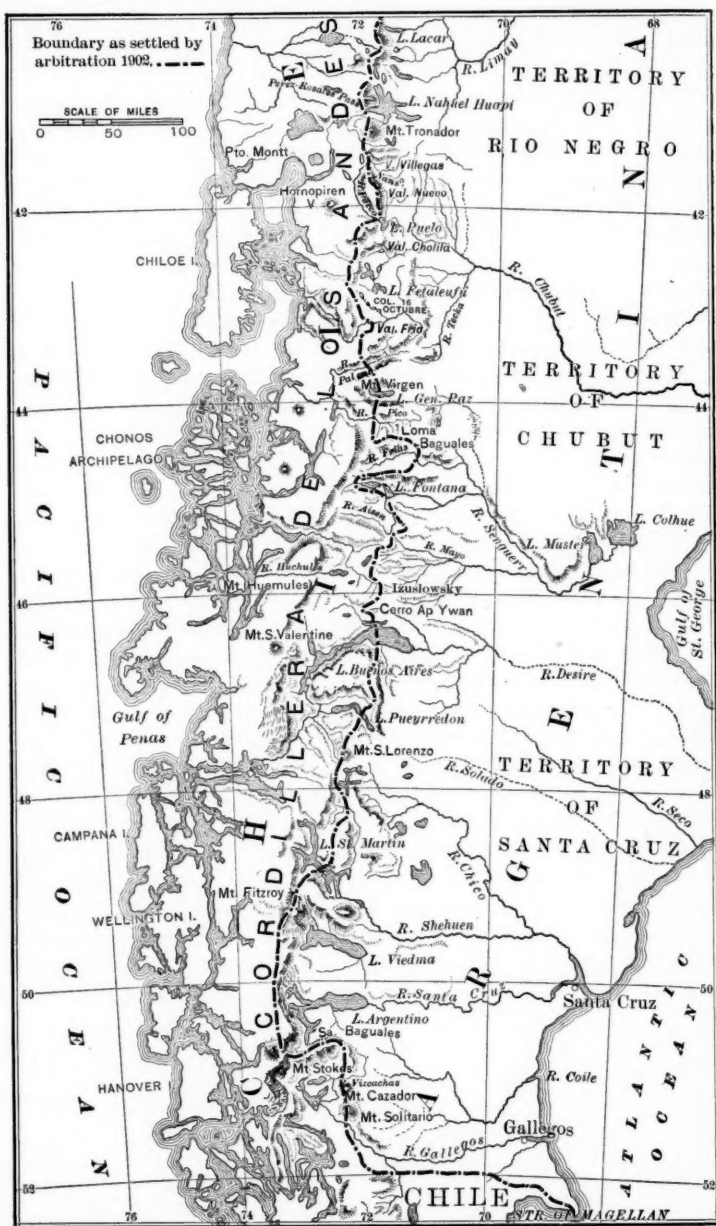
## THE BOUNDARY BETWEEN CHILE AND ARGENTINA.

The long dispute between Chile and Argentina over their boundary has been brought to a satisfactory conclusion by the award of King Edward VII. of Great Britain. The King's decision, determining the position of the boundary line, is based upon the recommendations of the Arbitration Tribunal that has been studying the questions involved for the past two years. The position of the boundary as now settled is shown in the accompanying map. It is a compromise between the respective claims of the two countries.

Under the arbitration Chile gains more territory than falls to Argentina, particularly in the southern portion of the region that was in dispute; but the territorial gain for Chile is at least of no greater importance than the smaller area which Chile claimed, and which has been conceded to Argentina.

The disputed region among the Southern Andes, which is now largely assigned to Chile, is not adapted for important development; while the Welsh Colony of Diez y Seis de Octubre and the Nuevo and Cholila valleys shown on the map to the north of it, now definitely assigned to Argentina, are rich regions with fine soil and abundant grasses, capable of large development, both for the agricultural and grazing industries.

Chile, on the other hand, secures a large amount of fine forest land, and also uplands in Patagonia, well adapted for sheep-raising, which Argentina had claimed. On the whole, it is doubtful if a fairer award could have been made; and the two countries are to be congratulated upon the settlement of a dispute that had become prejudicial to their business interests.



NEW BOUNDARY BETWEEN CHILE AND ARGENTINA.

## NEW MAPS.

### AMERICA.

NORTH AND SOUTH AMERICA. Colonies Allemandes en Amérique. *Revue de Géographie*, January, 1903. Paris.

A sketch map showing the areas of largest German population in North and South America; with an inset showing the German colonies in Brazil colored according to density of population. The German colony in South Chile is not indicated. All the steamship connections between Germany and American ports are given.

UNITED STATES. The Stieler six-sheet map of the United States; comprising sheets 86, 87, 88, 89, 90 and 91 of the Ninth Edition of Stieler's Hand-Atlas. Gotha. Justus Perthes, 1902. (In German.)

Although only about one-fourth of the sheets of the ninth edition of the Stieler Hand-Atlas has as yet been issued, the published portion includes the six-sheet map of the United States. This map has long been worthy of the special attention of our citizens as the best foreign map of this country. The scale, 1:3,700,000, or 57.84 statute miles to an inch, is not large enough adequately to show the country in its more minute geographical relations, but for most purposes the map is superior to many published in the United States. The new edition differs much from its predecessors, particularly in the methods employed for showing topography. In earlier editions colour was used almost entirely to denote boundary lines; in the present map the hill hachuring is emphasized by brown tints, so that all the higher elevations stand out in bold relief. The most striking change, therefore, is that the new map presents topographic aspects more vividly.

The heights were formerly shown in English feet, but they now appear in metres—an innovation that may not be enthusiastically received here, as we are not yet accustomed as a people to the metrical system. Hundreds of heights above sea-level are given for lakes and mountains. Place names have five different symbols to indicate approximately the size of each town according to the last census. It is evident that the sheets of the topographic map which the United States Geological Survey is making have been utilized to present the latest ascertained facts. For example, the Catskill sheets, thus far issued, have helped to improve the delineation of that region on the new Stieler map. Little streams, like the Schoharie and Batavia, are traced from source to mouth, though there is no room to print their names; and their drainage basins are plainly defined by the distinctly-marked hill features.

Three scales are given, nautical and English miles and kilometers. Sand areas are tinted yellow and lakes appear in blue. The Territories are distinguished from the States by differently indicating their boundary lines. An excellent idea of the large amount of information that may be presented on a small scale map may be obtained by observing on these sheets the lighthouses, sand banks and reefs along the coast, the conspicuous delineation of national parks, Indian and military reservations, leading mining districts, chief lines of railroads and telegraphs and hundreds of heights above sea-level for the lakes and mountains. To present so much information it is, of course, necessary to eliminate many place names, though the nomenclature, considering the scale, is certainly large.

All map lovers in our country will enjoy the study of this admirable product, which scientifically presents the best attainable information.

NEW JERSEY.—Geological Survey of New Jersey. Trenton East and Atlantic City sheets. Scales in feet, metres and miles,  $2\frac{3}{8}$  inches to a mile. Contour interval 10 feet. Edition of 1902. C. C. Vermeule, topographer; Henry B. Kümmel, State Geologist, Trenton.

The areas covered by these sheets were resurveyed in 1901. The street plan of the towns is clearly shown on so large a scale.

#### AFRICA.

THE CONGO RIVER.—A map of the Congo River between Leopoldville and Stanley Falls—Scale 1:250,000, or 3.9 statute miles to an inch. By the Rev. George Grenfell. *The Geographical Journal*, 1892, sections 1, 2 and 3 in November, and 4 and 5 in the December number.

Grenfell's running surveys of the navigable upper Congo between Stanley Pool and Stanley Falls, made in the steamers *Peace* and *Goodwill* (1884-89), have at length seen the light. The Royal Geographical Society has rendered a distinct geographical service in publishing this carefully-prepared material, which is a very valuable addition to the mapping of the Congo. The courses and bearings were laid down from some 200,000 cross bearings; about 1,500 altitudes were observed for latitudes and about 1,200 for time and longitude. All channels between islands more than a half mile in length excepting those indicated by dotted lines have been navigated. Indications of the topography along both banks of the river are given as far as Bolobo. The index chart performs an additional service by showing along the courses of the five southern tributaries and the Mobangi (northern tributary), which Grenfell explored, the date and place of publication of his maps of these discoveries.

WEST AFRICA.—Essai de carte des Régions Botaniques d'Afrique Occidentale—Scale, 1:15,000,000, or 235.3 statute miles to an inch. By A. Breschin. *La Géographie*, 1902, No. 4.

Indicating the areas occupied by the principal kinds of trees from the west coast between Senegal and Angola to Central Africa—the oil palm, the kola, and the shea or butter tree; also the southern limit of the date and Egyptian palms, and the northern limit of the borassus palm and the banana.

AFRICA, GENERAL.—Cinq Cartes d'Afrique. Nouvelle édition, 1903, par M. le Général Niox, en un fascicule. Paris. Librairie Ch. Delagrave. Price, 6 fr.

These five sheets from General Niox's Atlas de Géographie Générale, revised to date and issued as a special number, will be welcomed by students of Africa, and are of special interest to the French nation, as all the sheets, except on the general map, relate to parts of the continent in which France is most concerned. The latest data as to political boundaries, discoveries and corrections are given, but the well-known house of Delagrave does not yet seem to have heard that the former Boer republics have passed under British sovereignty. The maps are: Afrique—Scale, 1:16,000,000, or 251 miles to an inch; Algérie et Tunisie—scale, 1:2,000,000, or 31.5 miles to an inch; La Région Saharienne Française—scale, 1:4,000,000, or 63.1 miles to an inch, showing the desert routes along which French enterprise is being extended towards the Sudan, Senegal, and Niger regions—scale, 1:8,000,000, or 126.2 miles to an inch; Congo-Nil—scale, 1:8,000,000, or 126.2 miles to an inch. This map contains considerable new geographic information, particularly with regard to the inland portion of the French Congo.

## ASIA.

SIAM AND MALACCA.—Siam und die Halbinsel Malakka—Scale, 1:12,500,000, or 197.2 statute miles to an inch. Deutsche Rundschau für Geographie und Statistik. 1903. Heft 4.

Showing in colors the new French-Siamese boundaries and the French and English spheres of interest in Siam.

COREA.—Seoul sheet of the map of Asia, now in course of publication by Le Service Géographique de l'Armée. Scale, 1:1,000,000, or 15.78 statute miles to an inch. Paris. Price 1 f.25 cent.

Corea is usually presented in atlases on a scale too small to indicate much detail, though the native maps, as well as foreign studies, have supplied a large amount of valuable material. This sheet shows nearly the whole of Corea, with a large number of place names, many roads, and topographic features differentiated by light and shadow. Sea depths along the coasts, and across Corea and Broughton Bays, are shown by contours and soundings. The production of these useful maps is worthy of all encouragement.

ASIA MINOR.—Regenkarte von Klein-Asien. By Dr. R. Fitzner. Scale, 1:3,700,000, or 58.3 statute miles to an inch. *Petermanns Mitteilungen, Ergänzungsheft* No. 140, 1902. Gotha. Justus Perthes.

Showing in six tints the average amounts of precipitation throughout Asia Minor, and illustrating Dr. Fitzner's monograph on rainfall and cloudiness in Asia Minor, to which this *Ergänzungsheft* is devoted.

## ATLASES.

STIELER'S HAND-ATLAS. Neue, Neunte Lieferungs-Ausgabe. 100 Karten in Kupferstich. 9 and 10 Lieferungen. Gotha. Justus Perthes. Price, 60 pf. for each part containing 2 map sheets.

This double part contains four sheets: No. 37, the northern sheet of a map of Great Britain, drawn by O. Koffmahn. Scale, 1:1,500,000. A new map, with insets of the Scottish Lowlands, Edinburgh and its surroundings, and the Orkney and Shetland Islands. No. 67, Islands of the East Indies, by C. Barich. Fourteen maps on one sheet (new), of the leading islands and island groups, on a scale of 1:7,500,000, or 118.3 statute miles to an inch, for the leading islands. Small as this scale is, it is larger than that of most atlases for this part of the world, and larger than that of the maps of the Philippines, Borneo, Sumatra and Celebes hitherto presented in this Atlas. A map of the Philippines, for example, on a scale of 118.3 miles to an inch, as on this sheet, is too small to serve adequately the purpose of even ordinary newspaper reading. To give only one illustration of this fact, not half of the eleven more or less active volcanoes of the Philippines are shown on the map; and no one could deduce the fact by studying this map that the great Taal volcano lies in the middle of Lake Bombon. The attention of cartographers may properly be called to the "Report on the Seismic and Volcanic Centers of the Philippine Archipelago" by M. Saderra Masó, S. J., Bureau of Public Printing, Manila, 1902.

ATLAS UNIVERSEL DE GÉOGRAPHIE. Ouvrage commencé par M. Vivien de Saint-Martin et continué par Fr. Schrader. No. 3-Mappemonde. No. 19-Espagne et Portugal en 4 feuilles (feuille sud-ouest). Scale, 1:1,250,000, or 19.7 statute miles to an inch. Paris. Librairie Hachette et Cie. 1902.

The accurate information and the sharp and clear definition of topographic

features presented on the sheets of this Atlas make it all the more regrettable that the interval between the publication of the sheets is so long. It is about eighteen years since the first sheets were published, and twenty-six of the ninety sheets still remain to be issued. The whole of Europe has appeared excepting the general maps of the British Islands and Iberian Peninsula and the southeast sheet of Spain and Portugal in four sheets. Nine of the fourteen sheets of Asia, six of the twelve sheets of Africa, six of the twelve sheets of North America, and the whole of South America and Oceania have been issued. No. 3 is a hypsometric map of the world in hemispheres, six colors showing land altitudes and six tints of blue indicating sea depths, with smaller maps giving meteorological and climatological data, zones of vegetation, and ocean currents. No. 19 is the southwest sheet of the four-sheet map of Spain and Portugal, with inset maps of the Canaries and Azores.

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## PHYSIOGRAPHIC NOTES.

BY

RALPH S. TARR.

RIVER PIRACY IN SOUTHEASTERN MISSOURI.—Although it is probable that the last word on Crowley Ridge has still to be said, Marbut (University of Missouri Studies, Vol. 1, No. 3, 1902) has done much to clear up the problem which this interesting upland presents. Written upon by Call and by Branner, and studied later by Marbut, while a student at Harvard, the Crowley Ridge presents problems that have led Marbut to extend his investigations and survey over a period of four years, and it is with the results of this study that his present paper deals. He arrives at substantially the same general conclusions that Branner reached in 1889, bringing forward additional evidence in many cases, and contributing pertinent facts as well, concerning the processes of stream development and river capture.

The area discussed lies in Missouri, near the confluence of the Mississippi and Ohio, and consists of two main areas of lowland, separated by several upland ridges, of which the Crowley Ridge is the largest. The lowland between Crowley Ridge and the Ozark Upland is an abandoned valley of the Mississippi, which formerly joined the Ohio some distance below their present junction at Cairo. Marbut's studies show that the Mississippi cut this inner bottomland, while the much larger lowland area east of Crowley Ridge was made by the Ohio. The Mississippi was, later, twice diverted from its course, eventually entirely abandoning its lowland, being

diverted through the narrow gorge into which the river sharply turns just below Cape Girardeau.

That a stream so much larger than the Ohio as is the Mississippi should have been able to make a lowland belt very considerably smaller than that developed by the smaller stream would naturally invite an investigation of the causes and influences to which the streams have been subjected; and when the further facts are considered that the Mississippi has twice left its developed course, abandoning in the first case 200 miles and in the second 50 miles of its valley to flow through a narrow gorge which had to be wholly readapted to fit its new occupant, and that the latest turning aside is so recent that Paleozoic rocks in the stream course still form a dangerous rapid, the "Grand Chain" just below Cape Girardeau, it seems worth while to look into the causes which result in stream capture generally, and especially those which have operated here. The twice-repeated filching of the larger stream by the smaller has resulted from the combination of favourable conditions and suitable intervals of time for their operation.

Marbut shows that the development of the larger lowland by the Ohio is due to the fact that it was working in soft, unconsolidated rocks, the Tertiary clays and gravels and Pleistocene loams and loess, while the Mississippi was held up by the indurated Paleozoic limestones and sandstones of the Trenton. Moreover, the Mississippi has a steeper grade than the Ohio; it was not relieved of its heavy burden by the melting back of the ice-sheet from its headwaters until after the Ohio, and it was never relieved of the loads of sediment dumped in by the Missouri. Consequently the Ohio has been able to push back its divide into the drainage area of the Mississippi and rob it of some of its tributaries. The Mississippi, cutting against the low divides thus formed, has pierced the valley of its own captured tributaries at a low enough point to be diverted into the lower valley, and hence into the Ohio itself. Thus, in re-capturing its captured tributaries the Mississippi has

found it necessary to abandon two valleys in succession, after each was eroded down to grade and opened out to a width of several miles, in favor of the valleys of small creeks, which it had to work over and enlarge in order to make them suitable for its purpose.

The writer discusses the diversion of each of the several creeks, giving an excellent discussion of river capture. How capturing was done is summed up in the following quotation:

The valleys of two streams are separated by a narrow belt of upland. A small stream flows into one of them, heading on the upland between the two main streams. That one of the larger streams into which the small stream does not flow saps

the bluff on the side nearest the other large stream, gradually working toward the head of the small tributary. By continued sapping it finally cuts off the head of the tributary; then, continuing, cuts off more and more of it, reaching a lower and lower level of its valley, thus deepening the gap between its valley and that of the other large stream. It finally reaches a point where it can shorten its course by flowing into the other stream through the beheaded trunk valley of the tributary, abandoning the lower part of its own valley.

Other interesting physiographic points brought out by the paper concern themselves with questions incidental to the main problem, among which the beheading of the Crowley Ridge drainage may be noted. The work has been exhaustive; some of the applications are ingenious; they all seem rational.

THE ORIGIN OF HANGING VALLEYS.—Professor Davis's recent paper on the hanging valleys of the Alps and elsewhere, in which he explains them by glacial erosion, has called forth two papers opposing his explanation, one by Bonney (*Quarterly Journal Geological Society*, LVIII, 1902, 690-702), the other by Garwood (Same, 703-718). Bonney's paper opens with a criticism of Professor Davis's methods, stating essentially that he had hurried over the region and jumped at a conclusion. Those who are more familiar with Professor Davis's powers and methods are aware of the fact that he was prepared for his investigation by a long previous study of Swiss topographic sheets and by a long and diverse experience in the study of the physiography of many regions. Moreover, Professor Davis's training and powers are such that he is able to see where others do not.

That Bonney is not in sympathy with the development of physiography that has been made in the United States is shown by a number of passages in his paper. He, for example, states that he prefers the old term dip and strike valleys in the place of the newer consequent and subsequent, as if these terms were really synonymous.

The paper by Bonney is prefaced by some remarks concerning the earlier history of the Alps. He holds that the action of snow is conservative rather than destructive, that cirques and over-deepened valleys have been formed by running water, and that the erosive work of ice has been on a small scale, such as the formation of shallow basins and roches moutonnées. On the other hand, he points out the fact, to which every one will agree, that water is known to have the power of excavating, and, moreover, that its work can be seen. Therein appears to lie the chief difficulty that stands in Bonney's way—namely, that he cannot see ice erosion in

progress. He seems to hold that because small glaciers near their margins are not at the present time doing great tasks of erosion therefore ice has never done much work of that sort.

His view of the origin of the hanging valleys is as follows: The Alpine valleys are almost wholly preglacial, the gorge cutting dating from late Pliocene times. The hanging valleys are due to the fact that glaciers remained in the side valleys, thus checking denudation, while the downcutting of the main valleys was increased by the torrents of water coming from the melting ice. He cites many instances in support of this view, and concludes that, while Professor Davis's hypothesis derives little support from the facts, his own hypothesis is far better supported.

Garwood's paper is, in general, similar to Bonney's, though he seems to have more respect for Professor Davis's work. In fact, he says that Davis states the facts regarding the Ticino valley correctly. His attention was first attracted to hanging valleys in the Himalayas, and he has studied the Ticino and numerous other valleys. According to his interpretation, the region of the Ticino valley was uplifted, and the hanging valleys produced, probably during interglacial times, being occupied, as Bonney has suggested, by glaciers, which preserved them. He concludes that ice is a weak agent of erosion, from observations he made at the ends of the glacier in Switzerland and in the Arctic. It seems exceedingly strange to find two men applying criteria from the weak ends of small glaciers in the interpretation of work done by deep ice moving vigorously over a region. It is much like examining a small stream flowing through a meadow and from it concluding that a river could not cut out a Colorado cañon. To interpret correctly the work performed by great ice masses, one must divorce himself from prejudice at the outset and be ready to accept the result of observed fact; no matter what his preconceptions may have been concerning the powers of the agent. Perhaps there is no one who would hold that ice is not protective when compared to the work which is done by rivers; but to admit this is far different from holding that, while ice protects a valley which it occupies, it is nearly inactive.

After reading these two papers the physiographer cannot help wondering whether either of the authors is in sympathy with the basal principles of the new physiography. For example, Mr. Garwood speaks of the hanging valleys of the Italian lakes, mentioning especially the one at Menaggio, on Lake Como. These he ascribes to the holding up of lake waters while the hanging valleys developed

at that temporary base level. Lake-lowering, then, allowed the hanging valleys to be downcut. This process is truly a possibility; but one is warranted in asking several questions. Has time enough elapsed since the lakes were formed to permit the formation of the broad valley that hangs above Lake Como at Menaggio? It has a mature form. The required time for so mature a valley must have been great enough for the lake to be nearly or quite filled. The gorge which now takes the water through this hanging valley into Lake Como is young enough to be postglacial in age. Where, then, are the lake beaches and deltas that were formed at this higher level? And what accounts for the depth of the Lake Como valley below the level of the hanging valley? These are physiographic difficulties which seem utterly opposed to Garwood's explanation.

The hypothesis that hanging valleys were caused by the protection of ice tongues brings forward one or two difficulties which seem far more serious than that of explaining how ice can erode. The over-deepened valleys to which the hanging valleys are tributary are quite wide and U-shaped; that is, their form is such that, if formed by water, no small amount of time has been required. During this time the hanging valleys must have been filled with ice tongues almost down to the edge of the main valley. This requires a period of stability in ice position quite unlikely to occur. If the ice tongues did not nearly fill the hanging valleys during the deepening of the main valleys either one of two things must have happened: (1) Either the outrush of water must have cut gorges, or (2) the water must have been so overburdened with sediment as to have built wash deposits. The absence of either of these evidences of ice occupancy is certainly suggestive. It seems like appealing to a most unnatural cause to explain what is far more simply explainable by ice erosion.

Finally, and as a very strong argument in favor of ice erosion, is the fact that well-defined cirques and over-deepened and hanging valleys are among the common features of glaciated regions, while they have so far not been reported in unglaciated regions. Moreover, there are hanging valleys in many places where the theory of protective ice tongues could not even be advanced; for example, in the hanging valleys tributary to the Lake Cayuga valley, in central New York. In unglaciated regions side valleys are in harmony with the main valleys. The Colorado River, for example, is rapidly cutting along its bed. Its small tributaries are weak in the extreme, being free from water during a large part of the year; yet at their

mouths they are able to keep up with the vigorous work of the main stream.

In these comments on the two papers I do not bring forward again the statement regarding overlapping spurs which Professor Davis brings out in his paper. From what Bonney and Garwood say it seems evident that neither of them appreciates the full significance of this evidence in favor of glacial erosion.

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## THE HUICHOL INDIANS OF MEXICO.

BY

CARL LUMHOLTZ.

There are living to-day in Mexico about fifty different tribes of Indians, each speaking its own language. Besides, over a hundred and fifty dialects are spoken, so that in all there are in use in that Republic as many as two hundred idioms, none of which is understood by those who speak the others. This diversity of language is partly due to the taciturnity and exclusiveness of the Indians.

In this conglomeration of tribes four were found, at the time of the Conquest, to be far superior to the others, and in possession of a remarkably high culture. These were the Aztecs, the Mayas, the Mixtecs, and the Zapotecs. When the Spaniards invaded Mexico they found these tribes practicing the art of picture writing in their peculiar books, as well as on their stone monuments. Their wonderful architecture and sculptures, the high development of their governmental and religious systems, the barbaric splendour and wealth in which these nations lived, not only baffled the invaders, but the better they become known to the civilized world of the present age the more they excite wonder and admiration. In many sciences, especially in botany and astronomy, these so-called barbarians were in advance even of the Europe of that time. Yet at the very doors of these highly-advanced races there dwelt tribes, such as the Huichol Indians, whose limited intellectual power forced them to remain mentally and socially in an absolutely primitive condition. Strange as this may seem, the fact in itself is by no means unique. Similar instances of wide diversities of culture

existing side by side may even to-day be observed in all the South American republics and in several European countries. It would be as unjust to judge a Filipino from some low-grade Negrito tribes of those islands as it would be to take for a representative American a Moqui Indian dancing with a rattlesnake in his mouth.

The Huichols, although related to the Aztecs, belong to those tribes that remained undeveloped while the Aztec Empire rose and flourished. Montezuma's reign came to a terrible end nearly four hundred years ago; while the humble Huichols have maintained themselves to the present day in their inaccessible mountain fastnesses. True, they, too, were conquered by the Spaniards in the course of the last century; but the impression the victors made on them was so superficial that to-day the tribe practically dwells in the same state of barbarism in which it resided prior to the time when Cortes first set foot on American soil.

These people occupy a small portion of Central Mexico towards the Pacific slope, and number about four thousand souls. They are called by the Mexicans "*los Huicholes*"—a corruption of the tribal name of "*Virárika*," which signifies "doctors" or "healers"—a name they fully deserve, as about every third man of them practices that profession. The region belonging to them is, I should judge, some forty miles long by twenty to twenty-five miles wide, and covers the southern spur of the great Sierra Madre range. Of their country the Jesuit Father Ortega says:

It is so wild and frightful to behold that its ruggedness, more than the arrows of its inhabitants, took away the courage of the conquerors; because, not only did the ridges and valleys appear inaccessible, but the extended range of towering mountain peaks confused even the eye.

Franciscan missionaries followed the conquering soldiers, and built four churches. Nominally, the tribe became converted to Christianity; but to-day the churches are in ruins, while the old beliefs, customs, and ceremonies retain an unshaken hold on the minds of the people.

On a morning oppressively hot, in the beginning of June, 1895, I found myself on the way to that country, accompanied by four Mexicans and one Cora Indian. We were on the slope of the mountains that form the western barrier of the country, which has the reputation of being accessible only at four points. We had still several days' climbing before us, and were just packing our mules, when the father of one of my Mexicans came running up to us with a message that seemed quite alarming. News had reached the valley we had left on the day before that the Huichols were up in arms

against that white man—meaning myself—and determined to prevent his entering their villages. The messenger impressed upon my men the necessity of turning back, and implored them not to run any risk by accompanying me. The men immediately stopped packing, and proposed to go back at once. They declared that the Huichols were bad; that they were assassins, and would kill us all.

By dint of much persuasion and some threats I managed to keep my company together, and four days later we arrived at the pueblo of San Andres, where we found a great many Indians gathered on the occasion of a rain-making feast.

I had sent a man ahead to advise the people that I was coming; that I meant no harm to them, and that their neighbours, the Cora Indians, had received me well. Nevertheless, a few were so put out at the unusual appearance of my expedition that they threw down their sombreros and fled into the forest. But the main part of the population received me in a stolid silence, accepting my baneful presence as something they were powerless to avert.

Fortunately, my arrival did not prevent the feast from coming off, as the Indians never allow anything to interfere with the proceedings of their ceremonies. A great event, the sacrifice of an ox, was to take place next morning, and the night preceding had to be devoted to singing, which began shortly after sunset. One man, a singing shaman, was the leader; and he related in song the mythical events of ancient times and the heroic deeds performed by the gods. Each stanza, as he sang it, was repeated by the multitude in front of him. I was astonished at the fertility of the Huichols in what we should call "legendary lore," but what to them is gospel truth and history. There are no written records kept of these traditions. They live on the lips of the people, as national heirlooms, passing from one generation to the next, as originally did the sagas and folk-songs of the ancient Northmen. If he had the physical endurance, a strong shaman could keep on singing new verses night after night for at least a fortnight. I also noted with admiration the quality of their voices. I have never, in any native tribe, heard such good singing.

The purpose of the song was to induce the gods to let the rain come down. The fervour of their efforts was not at all abated by the fact that torrents of rain were already falling before they started their ceremonies; their object now being to prevent the rain from stopping. My wishes were just as fervent in the opposite direction, as the rickety shed that had been assigned to me as my quarters was by no means waterproof. I became, however, reconciled to my fate

by the really beautiful singing of the leader. The steady downpour of the rain, punctuated by fitful flashes of lightning, formed a weird and fantastic accompaniment to the sympathetic singing that came to me through the pitchy darkness of the night, like a voice from fairyland. It was different from anything I had ever experienced among Mexican Indians, or elsewhere, and it seemed as novel as it was enchanting. From that day on I lived with the tribe for about a year.

Knowing that they hated all Mexicans, I discharged and sent back to their own country the men I had brought along with me. I was, therefore, now alone, "a stranger in a strange land"; and there being no hotel accommodations, I became a boarder in a Huichol family—the first and only one they have ever accepted. The conversation at meals was at first limited, as my host's knowledge of Spanish was confined to about a dozen words, and I had not yet learned any of the Huichol language.

While the people remained distrustful and disobliging, I was biding my time. I went to the many feasts that were being held in the temples, and by and by I learned a few stanzas of their songs; and as soon as they heard me sing these to them the situation became changed. They began to feel confidence in me, and to think that I might become of benefit to them. They considered it as something meritorious on my part that I could sing their songs; and the mere ability to mention the names of their gods in this way served me as a protection against any designs they may have had against me. I have even had occasion to utilize this knowledge among other tribes, who, while they did not understand the words, comprehended that the melody was of their own race, not a white man's, and any utterance of it struck a responsive chord in their hearts.

From that time on I was treated with something like friendly consideration, and was taken to all their sacred places, caves, etc. At my request they showed me everything, and, though sometimes reluctantly, would sell me anything I wanted for my collections. But to get correct explanations from these people regarding anything connected with their religion is the hardest part of an ethnologist's task—far more difficult than the collecting and buying of things. First of all, I had to find the proper man to interview, because the mass of the people are ignorant in comparison with the well-informed shamans. These (combining, as in ancient times, the office of priest with that of doctor) are, so to speak, the scientists of the tribe. The next difficulty to overcome was to get

them to answer my questions truthfully. They naturally suspect that some harm may come to them from divulging their secrets to a stranger, as such indiscretion may upset their relation to the gods. Therefore, often they only pretend to give information, while in reality they give you falsehoods and evasions. When, after three or four weeks' searching, I had managed to find the proper man, he generally turned out to be a sympathetic, kind-hearted individual, full of enthusiasm for his faith. But now a new difficulty presented itself in the fact that the brains of these people are so unused to any mental exertion that answering questions soon proved too much for them. It has happened that not only the shaman himself, but the several Indians I had to assist me in interpreting, would drop off to sleep. I had to let them go, because they were exhausted, tired out. After that it would require weeks or months before they would consent to submit to a similar ordeal.

Dealing with these people, therefore, requires an endless patience. But when one succeeds he feels amply repaid for his efforts. There is nothing quite so gratifying as to rescue from oblivion the old myths and traditions that have never been told to a white man before. The glimpse revealed to you of the first faltering steps of the human mind, of the first dawn of history, makes you forget all the hardships and privations you have to submit to in order to obtain it. As the tribe had never been studied before, and as it is not yet contaminated by civilization, I had cause to believe that my labours among them would become of considerable scientific value.

The Huichols are of medium height, well built, of a light chocolate-brown colour, and very healthy. It is rather interesting to note that their babies, before they learn to walk, crawl on all-fours, not on their knees and hands, as do white children. Fond as I am of the Mexican Indians, I am bound to state that they have two failings, which, however, they share with many civilized persons. They have a great inclination to appropriate little things that strike their fancy, although they have never stolen anything from me; and then they do not tell the truth unless it suits them. Highly impressionable and exceedingly emotional, they are easily moved to tears or laughter. They are not warlike, and, if it is necessary to kill an enemy, they prefer to assassinate him.

Their daily life passes much in the same rounds as that of other Indians. The women spend most of their time grinding corn on the metate, and the men make arrows and bows, which are still the only weapons they use in the chase. They also make a weak native

brandy from the root of the maguey, and their distillery is of considerable interest.

The people live in houses generally circular, and at their ranchos there is always to be found a god-house for the worship of the local patron deity. The temples, of which there are about twenty, are built on the same plan as the houses, only much larger. In the centre of the temple floor there is always a place for the fire, which is kept up all night during the dances; but there are no idols here. These are kept in sacred caves in the mountains. Adjoining the temples there are always a number of god-houses, the inside of which presents a striking appearance, on account of the numerous ceremonial objects deposited to please the gods.

The agriculture of the Huichols is of the most primitive type, and consists in simply cutting down and burning the brushwood and then planting corn by digging holes in the ground with a stick, dropping some grains into each hole and closing the earth up again with the point of the foot. As there is little, if any, level land in their mountainous country, the people are obliged to plant on the slope of the hills, where most of the falling rain runs off without penetrating the soil. Therefore, almost incessant rain is needed in summer to make the crops grow. If it stops raining, even for only three or four days, the plants begin to be scorched by the heat of the sun.

As the Indian is thoroughly materialistic, and directs his entire thought towards procuring sufficient food, it will be understood how rain has become the main object of his prayers and the pivot on which his entire religion revolves. His fundamental belief is that the gods are all around him along the horizon, listening to what he says and watching what he is doing. They are angry with man, and grudge him everything; therefore, they also keep the clouds to themselves. But the shamans know how to propitiate them—to put them, so to speak, in good humour by singing of their great deeds in ancient times. The song pleases the gods, and then they let go the clouds. Thus the shamans, and indirectly the people themselves, are able to make it rain.

In addition to the singing it is imperative to make sacrifices of oxen, corn, and whatever else they may have; to hunt deer and to kill turkeys. The Huichol is devoutly religious, and his entire life is one endless devotion to his gods. From his birth to his death his actions are governed by the belief in his native deities, all his thoughts being ever directed toward pleasing them. On

important occasions he takes the advice of the shaman, who throughout his life stands by him in all his troubles, mental and physical.

Many feasts are held during the year—some to prevail upon the gods to bestow upon the people bountiful crops and similar benefits, others to thank them at harvest-time.

Of the greatest importance in the life of the Huichol is the cult of a small cactus, called by them *Hikuli*. This plant has become known to science only in late years, and is of considerable interest. When eaten it creates colour visions; more than that, it takes away all feeling of hunger, thirst, or fatigue, however intense these sensations may have been. Although it has a most exhilarating effect, the condition produced is altogether unlike that following the use of alcohol. The equilibrium of the body is kept better than normal, and a man is enabled to walk steadily and fearlessly along a precipice which otherwise would make him dizzy.

To obtain this plant the Huichols have to send each year deputations to the high central plateau of Mexico, the home of this cactus. The Hikuli-seekers have their faces painted with the colour of fire, and are equipped with plenty of plumes and tobacco-gourds. Something like six weeks are required for this pilgrimage. Considering the difficulties that must have beset these journeys in ancient times, when the lands of hostile tribes had to be crossed and recrossed, they are an eloquent testimony to the strength and fortitude which religious conviction will impart even to a barbarian soul. Not less than four months are spent in preparations for the feast celebrating the arrival of the fresh Hikuli. These preparations consist principally of prayers for success in hunting deer, as without the deer being killed the feast cannot come off. So prominent a part does the deer play in the religion of the Huichols that if by any chance this animal should become extinct the religion of the people would have to become modified.

The gods are, in the main, personifications of natural phenomena, as the sun, fire, water, and air. They are called Fathers, Grandfathers, Great-Grandfathers, and Elder Brothers, while the goddesses are Mothers. The main goddess, the mother of all the gods and of vegetation, is called Mother Nakawé, and resides in the nether world. There are a great many Mothers, chief among them those of corn, water, springs, and rain.

The Huichols also look upon their gods as the founders and ancestors of the tribe, the originators of the customs of the people, and the inaugurators of their religious ceremonies. Further, they believe that the gods even taught the tribe how to worship

them, in their own peculiar way. The Huichols, like the Aztecs, believe that they themselves made the Sun.

In the beginning, the Huichols will tell you, there was only the light of the moon in the world, and the people were much inconvenienced. The principal men came together to consult what should be done to give the world a better light. They asked the moon to lend them her only son, a limp and one-eyed boy. She at first objected, but at last consented. They gave the boy a full ceremonial dress, with sandals, plumes and tobacco-gourds, and his bow and arrows, and they painted his face. They then threw him into an oven, where he was consumed; but he revived, ran under the earth, and five days later arose as the Sun.

When the Sun radiated his light and heat over the world, all the nocturnal animals—the jaguars, the mountain lions, the wolves, the coyotes, the grey foxes, and the serpents—became very angry and shot arrows at him. His heat was great, and his glaring rays blinded the nocturnal animals; and with eyes closed they retired into caves, water-pools, and trees. Still, if it had not been for the grey squirrel and the gigantic woodpecker, the Sun would not have been able to complete his first journey across the sky. These two were the only ones who defended him; they would rather die than allow the Sun to be shot, and in the west they placed *tesvino* (a kind of beer) for him so that he could pass. The jaguar and the wolf killed the grey squirrel and the gigantic woodpecker, but to this day the Huichols offer sacrifices to these hero gods and call the squirrel father.

Not only is the entire territory of the Huichols full of sacred places, but also the land through which the Hikuli-seekers travel. In addition to these holy places, the people erect a number of god-houses, next to the temples, and also in lonely places in the forests. The most important of all the sacred localities is Teakata, where resides the most ancient idol, the God of Fire, besides a number of other deities.

The intense religious feeling and the desire to retain the favour of the gods manifests itself in a number of symbolic objects, which serve as embodiments of prayers and expressions of adoration.

As may be expected from beings whose life moves in such a narrow horizon, the symbolic objects are mainly those of their daily life; though some, like the shields, are no longer in practical use. They comprise, first of all, the paraphernalia of the warrior of ancient times: his front shield, his back shield, and his arrows.

The last, on account of their prime importance, we will consider first.

There is no problem in ethnology so difficult to solve as the meaning of the arrow in its different applications. It has a personal significance, and a relation to the clans into which the tribe is divided; and obliging though the Huichols were to me, they shrank from exposing so personal a matter. I have, however, succeeded in lifting a little of the veil of mystery that overhangs the arrow.

It is generally conceded that the arrow must be viewed as a bird with the neck outstretched, and the mystic power of the bird, which soars high and sees everything, is also attributed to the arrow. As the heart of the bird is between the wings, so the vital part or heart of the arrow is thought to be in that portion to which invariably feathers are attached, the so-called winged part. On this are painted symbolic decorations, consisting generally of longitudinal lines to indicate the path of the arrow, and zigzag lines to suggest its speed and strength.

Even primitive man has some idea of evolution and the struggle of mankind towards perfection. Therefore, we find in the Huichol myths that originally the arrows of the gods were made of a kind of stiff, coarse grass resembling bamboo, but lacking its strength. These arrows were too fragile, and the gods could kill rabbits with them, but not deer. They smeared rabbit blood on their arrows, yet that kind of blood was not very effective, and the arrows remained weak and ugly. The gods succeeded by and by in killing a doe; and after smearing that kind of blood on the arrows, the latter at once became strong and powerful, so that the gods could now go to hunt deer.

The arrow is a synonym for power, especially that of the gods. Thus the rattlesnake, the scorpion, and even the meteors, are arrows of certain gods.

Aside from the arrows used in the chase, there is another and very important kind, which is used solely as sacrifice to gain favour from the gods. In appearance this ceremonial arrow is much like the bow-arrow; but, as a rule, the rear shaft is more extensively decorated. What these decorations mean in each case is still largely a mystery. But this much is certain: that in a sense they are symbolic of the god to whom the arrow is dedicated; his coat-of-arms, or monogram, so to speak. On some arrows these markings are rather complicated, the decorations being divided into several fields, each having its own meaning. One may express the face of the god, another his wristlet; a red one may stand for the

blood of the deer, a green one for Hikuli, etc. Plumes, which are invariably attached to the arrow to speed it on its flight to the god, are always selected from a bird belonging to the special god to whom the arrow is addressed; for instance, the principal god, Grandfather Fire, has the royal eagle and the macaw—the latter on account of its brilliant fiery plumage.

The most common way to sacrifice an arrow is to stick it upright in the ground. Thus arrows may be found in all sacred localities; in springs and lagoons, in deep crevices between rocks, on the mountains, on the shore of the Pacific Ocean, wherever some god may dwell whom the imaginative Huichol desires to implore or to appease. For the arrow stands for him personally, or for the tribe, praying its silent prayer. "It talks alone," says the devout Huichol, meaning that it does not need the aid of the shaman.

More than anything else the Huichol uses the arrow to express his prayers and his adoration, and it is inseparably connected with his life. When preparing for any event of importance, he makes an arrow, thereby asking protection or favour from the gods. When a child is to be born into the family, the father's first duty is to make an arrow, and he continues to make arrows every five years for each of his offspring, until the boys are old enough to make their own arrows, or until the girls marry, when the husband assumes this responsibility. When the Huichol wants to hunt deer, or till the soil, or build a house, or marry, he has to make an arrow to insure success. In case of sickness, arrows have to be made to restore the patient to health; and when he dies, an arrow is stuck in the house, that the dead may not come back to disturb the survivors. Thus, from the cradle to the grave, in all conditions of life, arrows are made to smooth man's road as he journeys through life. Besides, in making arrows a man gains knowledge of all sacred things.

Not only are the arrows sacrificed by themselves, but they are also used as carriers of special prayers. The Huichol ties to them small front shields, back shields or mats, diminutive tobacco-gourds, sandals, bows, and many other objects expressive of certain desires. The idea is, no doubt, that the prayer is thus shot to that god whose address is painted in the coloured designs on the rear shaft.

The Huichols of to-day do not use front shields, but the shields are spoken of in their legends and myths. They use ceremonial shields as emblems of prayers for protection against evil and re-

quests for favours. Most of them seem to be dedicated to the sun, who, to the Huichol, is a man, whose shield is visible every time he climbs above the horizon. These ceremonial shields are made from split bamboo reeds, interwoven with variously-coloured crewel, so as to form a flat disk. Sometimes the traditional hole is left in the centre, but often it is only indicated in the weaving. The smallest shields may be only three inches in diameter; but there are also many which measure from twenty to twenty-five inches. What they lack in substantiality they generally make up in artistic merit, and the effect produced is frequently astonishing, considering the material at the command of the maker. Mythological, cosmic, and other ideas, all expressive of prayers, are woven into the shield and form the design.

It was a contemplation of these shields, hung up in a row, which caused my friend Mr. Cushing to suggest that the symbolism depicted on them makes it highly probable that these shields are related to the dance shields of the ancient Mayas. He thought that if these shields were hung up in the temples in some orderly array they would soon come to be considered as "speaking-shields," or an attempt to record events or deeds in visible form, and the next step would be to carve them on the walls as they are seen to-day.

Very different from the front shields are the back shields, which are also considered as mats or beds. Some of them are made of the same materials as the front shields; are rectangular in shape and present designs almost as beautiful. In conformity with the original idea of the back shield, as a protector against the fierce rays of the sun and the arrows of the enemy, the back shields have become very important media for prayers asking protection against evil. It is not uncommon to see depicted on them a mountain lion, which expresses a prayer that the god may protect the cattle against this ferocious animal. The Cora Indians complained to me that the Huichol tried to keep the clouds from reaching the Cora country by placing small back shields with designs of ferocious beasts in the roads, in order to frighten the clouds back and prevent them from leaving the Huichol territory.

There are also several other shapes in which back shields are made. Sometimes they are square and made by tying together splints of bamboo. Very often they are simply scraps of textiles woven for the purpose. In some cases back shields are made of grass. The grass is supposed to be the bed of one goddess, and the flowers that of another; therefore, these mats are prayers for rain, as neither

grass nor flowers grow during the dry season, but need the rain to blossom forth. But the idea connected with all the back shields is that the gods and goddesses are sleeping on them; hence the prayers embodied in the designs are in this way thought to be brought more efficaciously to the notice of the deities, who must see them when they are going to bed. Many prayers, for instance those for luck in handiwork, are expressed by back shields.

Another symbolic object of very great interest is the god's eye, called Sikuli, the idea being that it may rest on the supplicant and give him health and life. It consists, roughly speaking, in a diamond-shaped figure produced by interweaving the arms of a small cross with variously-coloured crewel. The *eye* is supposed to represent the flower of the squash; and at the feast of green corn and squashes these objects are attached to the heads of the children to insure their health. *God's eyes* are found in great profusion in the ancient burial-places in Peru, and in some cases they have been fastened to the false heads of mummies, serving actually as their eyes. This is a striking illustration of the wide distribution of some of the native ideas, as the same symbolic object is used by a multitude of tribes along the Pacific coast. It also demonstrates how the study of one American tribe may shed light upon the problems presented by another, though the latter be far removed from the former in time and space.

Finally, I will mention that votive bowls are also largely used as sacrifices and prayers. They are the ordinary drinking bowls of the Huichols, but much adorned with beads, which are fastened by means of beeswax, and form symbolic designs expressive of the desires of the giver. The idea which actuates this sacrifice is that the gods, when coming to use their bowls, will drink in the prayers of the people.

With the primitive implements and crude methods of the Huichols it is but natural that the products of this devotional industry should not be of a lasting nature. This is one reason why the ceremonial objects lose their power after five years and have to be renewed. Outside of each god-house are heaps of discarded ceremonial objects, from which an ethnologist may add to his collections. The people are kept busy making these curious objects, especially before each feast, when all the officers of the temple may be seen sitting around engaged in their manufacture. To the uninitiated it looks more like a toy factory than the solemn and prayerful preparation for a great ceremony of a pious and devout people.

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In extreme cases, when rain is badly needed, the Huichols will deposit what we may call an *ark*, in imitation of the boat in which the first Huichol rescued himself, when (according to their tradition) a flood drowned everything living on earth. This *ark* is deposited in a lake a week's journey south of the Huichol country, the idea being that what was once associated with water may again bring about the same effect.

Still more ingenious is the manner in which they try to attract the clouds by exchanging water between East and West. They carry a quantity of water from a sacred spring located two hundred miles east in the Hikuli country, and throw it into the Pacific Ocean, replenishing the spring by an equal quantity of water from the sea. In that way they think they make clouds pass over their country, because the water would feel strange in its new surroundings, and would want to return to the place it was taken from. As it has no other way of travelling than by rising in the shape of clouds, the two clouds have to pass over the Huichol country, where they meet and, bursting against each other, fall down as rain.

A constant diversity of meaning is naturally attached to the Huichol symbols. Thus, a pair of sandals of ancient pattern which are worn only by the shamans at their greatest feast have, in diminutive size, become a synonym for a prayer that the feast may come off; also a prayer that no harm may happen to the shaman at the feast. And, inasmuch as the feast cannot be celebrated unless a deer has been killed, a pair of such sandals also expresses a prayer for luck in killing deer. Finally, as in olden times only the men wore sandals, they may further express a woman's prayer to get a husband. But, despite the diversity of meanings attached to most symbolic objects, we can always trace a connection between the object and the symbolic meaning expressed by it.

In a few words I will now touch upon the conventionalism of the designs and patterns with which they decorate their clothing and household utensils.

It is erroneous to suppose that an Indian simply sits down and draws from his imagination when working out his often beautiful designs. No. Everything in primitive art has a meaning. The designs utilized are generally reproductions of animals, flowers, and household implements. But in time they have become so conventionalized that in most cases, owing to the innate artistic sense of the people, they can no longer be recognized by any one unfamiliar with them. Even the Indians themselves do not always know their

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meaning, and I got my best information from intelligent old women. Often I was not a little surprised at the ingenuity manifested in their technique. The designs are, so to speak, permanent talking prayers for protection against evil, requests for some benefit, or expressions of adoration.

The people sometimes adorn themselves with the corolla of a certain little white flower, called *toto*, fastening it to their cheeks with saliva. As this flower grows only during the wet season, it is symbolic of rain and corn. It is extensively used as a *motif* in their weaving and embroidering.

From the symbolism of the Huichols it must be inferred that the main consideration of all their prayers is food—corn, beans, and squashes. The means of procuring good crops is rain; therefore, the majority of all their prayers ask first for rain, and then for food, health, life, and luck.

The most striking feature of the world, as the Huichol looks upon it, is the prevalence of serpents. In all ages, and in most of the primitive religions, serpents have been of primary importance. In India the earth was called "the Serpent Queen"; in Greece, a serpent biting its tail was the symbol of eternity; in the northern and several other mythologies, the sea surrounding the world was thought to be a serpent encircling it. The serpent, by shedding its skin, rejuvenates itself, and thus becomes the symbol of health and strength. As it is the only animal that moves on the ground without legs, it is considered particularly cunning. Its great skill is further manifested in the beautiful markings on its back; and when the Huichol woman wants to weave or embroider anything, she passes her hand over the back of a live serpent held up by her husband, that she may thereby gain ability to do beautiful work. As in olden times the serpents were considered good guardians of treasures, so to-day the Indians leave their fields to be guarded by serpents. The Huichols believe that most of their gods and all their goddesses are serpents, and even the pools of water and the springs in which the deities live. In the sky, in the wind sweeping through the grass, the moving sea, the sinuously-flowing rivers, the darting lightning, the descending rain, in fire, smoke, clouds—in fact, in all natural phenomena—these Indians see serpents. Maize, the plant itself as well as the ears of corn, the bow with its elastic reaction, the piercing arrow, and even the tobacco-gourds—all are considered as serpents. It may be added that they see snakes even in their own flowing hair, in the girdles around their waists, in the ribbons

streaming from their heads and pouches, in their wristlets and anklets.

The sacrifices, symbolic and otherwise, that I have tried to describe may not seem very valuable from one point of view; often they are mere trifles. But it should be remembered that the Indians are poor indeed, and have not much to give away, and that the making of the things implies a considerable expenditure of time and labour. The Mexican Indian never gives nor expects anything for nothing; therefore, he has to pay the gods for everything he asks from them; and he gives according to his means, knowing that "only a knave gives more than he has." To us his efforts are of intense interest, as they reveal the first faltering steps of the human mind towards expressing thoughts in visible form when first dawned the possibilities of that art which has become the most fundamental and the most powerful—the art of writing.

Advancing civilization has as yet scarcely touched the Huichol country. Once a year a priest visits one or the other of their villages for a week or two, to baptize or to marry those who desire it; and he meets with no opposition as long as he does not interfere with the native religion. This is the case not only with the Huichols, but with all the Indians. They gladly accept Christianity, because, in their opinion, the more religion they have the better for them, as they are so much surer of getting what they always pray for—rain. But never will they give up their ancient beliefs as long as they have their land. When their country is taken away from them, when they become homeless and the servants of the white man, they lose their self-respect, become demoralized and indolent, and form the poor class of Mexico, as may be seen in the suburbs of the City of Mexico, where the once proud Aztecs are now the proletarians of the place.

## M. FROIDEVAUX'S PARIS LETTER.

PARIS, January 20, 1903.

The Marine Hydrographic Service, the history of which from its foundation in 1720 to the present day was briefly sketched in my letter of May, 1902, preserved throughout the 19th century practically the same organization, with but slight modifications. At present, by the decree of the 25th of September, 1901, the Service is under the direct orders of the head of the Marine General Staff. The *personnel*, composed of hydrographical engineers, higher and subaltern officers of the navy, administrative functionaries and technical agents, is divided into seven sections: (1) *Service of General Hydrography*; (2) *Service of the French Coasts*; (3) *Service of Charts and Archives, and Tide Service*; (4) *Service of Nautical Instruction*; (5) *Service of Scientific Instruments*; (6) *Service of Nautical Instruments*; (7) *Service of Nautical Meteorology*. Four of these, together with the Bureau of Administration, the storehouse and the library, are under the orders of the Director of Hydrography; the 4th, 6th and 7th Services, at the head of which is a captain or a lieutenant, are immediately under the chief of the General Staff. All the work of the different services, as well as the questions proposed by the Minister, are examined by a Hydrographic Committee, composed of the Director, two superior naval officers, two chief engineers, and a secretary, and are presided over by an Admiral.

The General Hydrographic Service is charged with the construction and issue of charts and hydrographic plans of the coasts in all parts of the globe, with the exception of France, Algeria, and Tunisia. It supervises the work of engraving the new charts, and, after the proofs have been passed upon by the Hydrographic Committee, gives the final order for printing. It is by this body, also, that the existing charts are kept up to the level of the latest information received, and published either in new editions or with simple corrections on the plates and charts. The expeditions sent out to survey distant coasts receive their instructions from the same source.

These expeditions, but lately occupied in the successful exploration of foreign shores (Brazil, Newfoundland, Japan, etc.), are at present restricted to our colonies, the coasts of which were

insufficiently known. Hydrographical engineers direct the more important of these enterprises, such as that of Madagascar, which in 1889-1894 and since 1899 has charted the northwestern coast of the island from Cape Saint-André to Diego Suarez, and has made partial reconnaissances of the most important points on the western coast, south of Cape Saint André. Other expeditions, embracing no long extent of coast, are made by officers of naval divisions: such are, in Africa, the survey of the rivers of the French Congo and French Guinea and that of the gulf of Tajurra; in Asia, the revision of the charts of the rivers in lower Cochin-China; in Oceania, the survey of the Gambier Islands, that of Tubiai, and that of the most westerly group of the Tuamotu Islands.

The results of these different expeditions have already appeared, or will appear, in the charts, of which there are now published by the *Service* nearly 2650, in various styles and scales: charts covering an ocean or a sea, and showing the lines of navigation; coasting and landing charts; charts of much-frequented coasts, where ports are numerous and ships keep close to the shore; special plans of ports, of anchorages, of straits and difficult passages, full of perils. All these charts are constantly corrected and kept up with the changes brought about by the development of navigation, by the creation of new economical relations, by the work of man and by the incessant operations of nature. Many of these corrections necessitate the issue of new editions of charts; those of a less considerable kind, such as the indication of an isolated danger or a change in a light or a buoy, are noted in special bulletins, and recorded on new issues of the charts.

The incidents of a geographical nature during the past two months have been few. Of these we may call attention to four addresses at the Conservatoire des Arts et Métiers on the subject of Oceanography. Two of these, by M. Julien Thoulet, were on the Science of Oceanography, one, by Dr. Portier, on Physiology and Microbiology, and one, by M. Joubin, discussed the Marine Fauna of the great depths.

In order to widen the public acquaintance with the vital questions relating to North Africa, the Administrations of Algeria and Tunisia have founded, at the Sorbonne and the Collège de France, two chairs, one consecrated to the Geography and the Colonisation of North Africa, the other to Mussulman Sociology and Sociography. The incumbents, MM. Augustin Bernard and Le Châtelier, open their course with a study, each from his own point of view, of Morocco. Another chair, that of American Antiquities, recently

established in the Collège de France at the instance of the Duke de Loubat, is filled by M. Léon Lejeal, who has selected for this year's course the Examination of the Spanish sources of Pre-Columbian American History, and, with this, the study of various questions of Mexican archæology.

If we turn to the explorations now on foot, we find but little that is of interest. In Africa, Lieut. Guillo-Lohan, an officer of the Territory of the Saharan Oases, has made, to the south of In-Salah, and notably in the regions of the Hoggar, an excursion which may be expected to yield good results. The Anglo-French Commission to settle the limits between the Niger and the Chad begins with the reconnaissance of the regions traversed by the conventional frontier of 1898, and, particularly, the famous Sokoto arc of the circle. The Commission is also to seek for a practicable route of approach to Zinder, capital of the Third Military Territory, the map of which, recently drawn by Capt. Moll, will now be completed and rectified by him.

In Eastern Africa Viscount du Bourg de Bozas has continued the explorations of which we have previously written. A letter of September 9 brought information that the party had reached Lamule, at the confluence of the Nile with the Niama, about midway between Lado and the Albert Nyanza. The travellers made their way to the bank of the Nile from the southern edge of the Abyssinian plateau, passing along the valley of the Usne till it joined the Omo, and then following this river and exploring the northern coast of Lake Rudolf, and then through the unknown country of the Turkwanas. They mapped their route with great care by astronomical observations, and made important collections in ethnography and natural history. M. Du Bourg de Bozas hoped to cross the Congo Free State and terminate his journey in the French Congo. No other French expedition of similar importance has been made in recent years; but we must not overlook the travels of Count Lesdain, of the Legation at Peking, in Mongolia, in June-September, 1902, through an arid and mountainous region and over the vast plains to the north of the Hwang-Ho, transformed by the periodical floods of the river into a lake in which the villages form so many islets.

Some excellent works call for attention, in the general sterility of scientific publications in the holiday season. The first is the Report to the Glacier Commission of the French Alpine Club on Variations of the French Glaciers in 1900-1901. The author of the Report, M. W. Kilian, confines himself to a careful account of

the glaciers of Dauphiné,\* accompanied by sketches and photographs, and followed by an admirable Review of Glaciology, full of facts and complete references, by M. Charles Rabot, who takes up, in succession: (1) The works relating to the physical and geological phenomena; (2) The recent explorations accomplished in the various glacial regions of the globe and the interesting phenomena of which he has taken cognizance; (3) The observations on variations in the length of glaciers. This Review, which is, in its line, as valuable to workers as the same writer's Review of Limnology, needs but one thing to make it complete: an index of names of places.

Thanks to the perseverance and productive resources of M. E. A. Martel and his scholars *speleology* has really become a special branch of natural science. The recent labours of the intrepid explorer of caverns throw new light upon several controverted points. Particularly important in this respect is the study of the subterranean river of Trépail (Marne) which constitutes the 88th Bulletin of the *Services de la Carte Géologique de France*. M. Martel's reconnaissance of this river in 1902 furnishes exact information on the circulation of the water in the chalk and seems to complete the overthrow of two very tenacious theories: that of the sheets of water in the calcareous and chalk formations, and that of the determination of the line of subterranean water-courses by the caverns. The explorations of Messrs. Van den Broeck and Martel at Han-sur-Lesse establish the fact (contrary to the recent statements of M. E. Dupont) that the subterranean Lesse is a single current, with occasional overflows and diversions of freshets and that the unknown portion of the course of the famous Belgian stream barely exceeds two kilometres. A most absorbing paper, published by M. Martel in the *Bulletin de la Société d'Etudes des Hautes Alpes*, on the Chouruns† of the Devoluy, calls the attention of speleologists to a field of exploration as yet almost untouched. The *chouruns* are not all known, nor is the position of their openings identified on the map, and it is too soon to make an attempt at their topographical classification; but M. Martel gives precise information concerning the Chourun Martin, the deepest abyss in France and, indeed, the deepest natural abyss yet known—at least 310 metres (1017 feet) and perhaps more than 500 metres (1640 feet).

\* This Report is, therefore, less complete than the two articles by Prince Roland Bonaparte, published in 1891 and 1892 in the *Annuaire du Club Alpin Français* on the Periodical Variations in the French Glaciers previous to 1890.

† *Chourun* is a local expression signifying *cavern* or *abyss*, and designating, above all, cavities descending perpendicularly to a very great depth.

Not less interesting, for another portion of the Alps, is the Study on the Formation of the Relief in the Diois and the Eastern Baronnies by M. V. Paquier, in *La Géographie*. This memoir is the complement of the Geological Researches of the same author in the region indicated, and it shows that the southern Diois, with its clearly-defined synclinal areas, almost east and west, is the continuation towards the north of the Baronnies, to which, moreover, it is tributary.

The geography of regions outside of France is not overlooked. M. Emmanuel de Martonne, of the Faculté des Lettres de Rennes, publishes, under the title of an Essay in Geographical Monography on Wallachia, a very complete study, fortified by travel in various parts of the country, and treating with equal care and attention the anthropogeographical and the geophysical aspects of the subject. This conscientious work, creditable in every way to its author, is illustrated by maps, sketches, and engravings.

The articles on the Natural Divisions of Algeria by MM. A. Bernard and Emile Ficheur, in the recent numbers of the *Annales de Géographie*, may be said to trace the plan of detailed work, the execution of which, it is to be hoped, will be entered upon in no long time. M. Edmond Douitté has contributed to the Bulletin du Comité de l'Afrique Française a summary report on his third journey in Morocco. This paper contains valuable notices on the tribes of the Hoûz. With it may be mentioned Capt. Cauvet's notes on the Touareg to the south of In-Salah; Lieut. Requin's account of a reconnaissance of the Mouydir plateau, executed by the *chef d'escadron* Laperrine, May 16-June 18, 1902; and the first part of M. Georges Thomann's report of a journey from the Ivory Coast to the French Sudan. A complete statement of the latest geographical work done in Madagascar, from the pen of Gen. Gallieni, is published in *La Géographie*, where also will be found the story of M. J. B. Charcot's excursion to Jan Mayen in 1902.

In historical geography M. Gabriel Marcel has published a notice of the plan of Paris, called the *Plan de Bâle*, the work of Olivier Truchet, who was the engraver of the maps of France and of Picardy by Jean Jolivet. The first volume of an admirably illustrated work by Messrs. Alfred and Guillaume Grandidier embraces a collection of works on Madagascar, published between 1500 and 1613, in Portuguese, Dutch, English, French, German, Italian, Spanish and Latin, either complete or in extract.

HENRI FROIDEVAUX.

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ZIMMERMANN, HENRI.—Dernier Voyage du Capitaine Cook. Berne, Nouvelle Société Typographique, 1782. 8vo.

BY GIFT.

*From Cyrus C. Adams, New York :*

All the Russias, by Henry Norman. New York, Charles Scribner's Sons, 1902. 8vo; Latest Maps of Eastern and Western Connecticut. Boston, G. H. Walker & Co., s. a., sheets folded in covers, 16mo; Atlas de Filipinas, por el P. José Algué, S. J. Washington, Government Printing Office, 1900. 4to.

*From Harlan P. Beach, Author, New York :*

A Geography and Atlas of Protestant Missions. New York, Student Volunteer Movement for Foreign Missions, 1901-1903. 8vo and atlas folio.

*From Prof. W. M. Davis, Cambridge, Mass., Author :*

The First Year-book of the National Society for the Scientific Study of Education; Part II., The Progress of Geography in the Schools. Chicago, 1902, pr. 8vo; The Terraces of the Westfield River, Massachusetts. *With plate.* [From the American Journal of Science, Vol. XIV., August, 1902]; Systematic Geography. [From the Proceedings of the American Philosophical Society, Vol. XLI., No. 170, 1902.]

*From Ch. Delagrave, publisher, Paris :*

Atlas de Géographie Générale: Afrique, Fasc. spécial de Cinq Feuilles. G. Niox. Paris, 1903.

*From the Verein für Erdkunde zu Dresden :*

F. von Bellingshausens Forschungsfahrten im Südlichen Eismeer 1819-1821. Aus Grund des russischen Originalwerks. Leipzig, 1902. 8vo.

*From Oscar Herrmann, Author, New York :*

Pirates and Piracy. With illustrations by Frederick Ehrlich, and an Introduction by Herman A. Heydt. New York, Stettiner Bros., 1902. 8vo.

*From Wilh. Dr., Freih. v. Landau, Author, Leipzig:*

Beiträge zur Altertumskunde des Orients: III. Leipzig, 1903. 8vo.

*From Dr. Wm. G. W. Lewis:*

CHARLEVOIX, P. DE (Translated). Journal of a Voyage to North America. Vol. 1. London, R. & J. Dodsley, 1761. 8vo.

*From Carl Lumholtz, Author, New York :*

Unknown Mexico. New York, Charles Scribner's Sons, 1902. 2 vols. 8vo.

*From Jules Mees, Author, Ghent :*

Histoire de la Découverte des Iles Açores et de l'origine de leur Dénomination d'Iles Flamandes. Université de Gand: Recueil de Travaux publiés par la Faculté de Philosophie et Lettres, 27<sup>e</sup> Fasc. Gand, 1901. 8vo.

*From the New England Catholic Historical Society, Boston :*

The Acadians of Madawaska, Maine, by Rev. Charles W. Collins. Boston, 1902. 8vo. *Publications of the Society, No. 3.*

*From Francis H. Nichols, New York :*

Ten Rubbings of Monuments and Inscriptions from the City of Sian, Shensi, China, including the Nestorian Tablet. *Sheets, mounted.*

*From Pettingill & Co., Publishers, New York :*

National Newspaper Directory and Gazetteer. Boston and N. Y. (1902). 8vo.

*From A. A. Raven, New York :*

New and Complete English Traveller, etc. London, Alex. Hogg. s. a. Folio.

*From the Royal Geographical Society, London :*

Map of the River Congo, with Memorandum: The Upper Congo as a Waterway. By the Rev. George Grenfell. 5 sheets, folded in case. London, R. G. S. (Reprinted from "The Geographical Journal" for November, 1902.)

*From F. C. Schrader, Author :*

Geological Section of the Rocky Mountains in Northern Alaska. *Bulletin of the Geological Society of America, Vol. 13, pp. 233-252.* Rochester, 1902. 8vo.

*From the Oficina Hidrográfica, Valparaíso, Chile :*

Ensayo de una Bibliografía Histórica i Jeográfica de Chile, por Nicolas Anrique R. i L. Ignacio Silva A. Santiago de Chile, 1902. 8vo.

## BOOK NOTICES.

*The Relations of Geography and History*, by Rev. H. B. George, M.A.,  
Fellow of New College. Oxford, Clarendon Press. Small 8vo,  
296 pp.

This is a welcome volume; for there has been little attempt to deal in a systematic way with the influence of geographic environment upon historical movements. In such essays as we have there is much loose assertion, made without proof of genuine causal relations. This author, at the outset, places a temperate estimate upon the effects of environment, and thus prepares us to consider seriously what he has to say.

The first eight chapters, nearly one-third of the volume, are given to an account of general principles, under such heads as frontiers, towns, nomenclature, sea power in peace and war, and geography in war. Under frontiers, natural boundaries such as mountain ranges, hill country, and rivers are treated, with considerable reference to defence and invasion. Town sites always have interest, in the great diversity and combinations of causal conditions, such as defensibility, depth of adjacent waters, and industrial possibilities. There is an interesting reference to Bristol, once the second city of England, and perhaps excelling even London in its shipping. Glasgow and Liverpool have left Bristol far in the rear, because the Avon does not offer easy access to large modern vessels.

History and geography are brought into close relation by nomenclature, and geographic nomenclature is well called "fossil history." Here is a little-worked field for geographers who have leanings toward history, and who can restrain themselves from vague philological speculation. Europe is usually cited as rich in examples of geographic nurseries; hence our author is out of the beaten track when he tells us that few natural boundaries in Europe are so definite as to require them to be political frontiers. The British Isles, the Spanish peninsula, Italy, and Scandinavia about conclude the list. One would think that the Grecian peninsula might be added. Easy havoc is made with Wordsworth's lines, in which he calls the mountains and the sea the natural homes of liberty. Mountain life is "compatible with the most backward civilization, with great capacity for tyrannizing over others." A

rather good case is made out from the Scottish Highlands and some of the cantons of Switzerland.

Environment does not produce, or at least does not insure, power on the sea, for the Spaniard had unsurpassed opportunities, but has never equalled Englishman, Dutchman, or even the French. Nor does race altogether determine who will love and follow the sea: the Boers certainly had maritime ancestors, but are now strangely averse to the ocean.

The rest of the volume is mainly devoted to the countries of Europe, in separate treatment, beginning with a general discussion of the Outlines of Europe. The chapter on the British Islands could hardly be other than good, for here many principles apply without question, and the writer is on his native soil. Absolutely primitive man has afforded no remains in Britain, but this was to be expected, for strong boats are required to cross waters as wide as the Straits of Dover, and such craft could only be fashioned by men who had made considerable progress in the arts. There is an excellent passage on the insularity of Britain, a condition, perhaps, more controlling than all other geographic considerations combined. The Norman invasion was successful largely because England was not united, and in a few generations Edward I, almost pure Norman by descent, was yet "English to the backbone." Military service, lasting a bare forty days, would not do for an island which had business of war on the mainland, and hence the crown grew in power at the expense of the nobility. There could be no sudden attacks, no disputes about doubtful boundaries, and there has been no real invasion since the Norman conquest.

Ireland is too small to form an independent nation, and is related to Britain by being on the outer side, instead of lying between it and the continent, where it might have been a bone of contention between Britain and the continental peoples. Holland, like Britain, is at the centre of the land hemisphere, and has exceptional maritime advantages; but she is not insular, whatever other reasons there may be for her inferiority to Great Britain. Within England, geographic conditions are now exercising an enormous influence in shifting the centre of population northward toward the country of coal and iron.

These must serve as samples of the interesting suggestions found everywhere in the volume. The single chapter of six pages on America is, of course, altogether inadequate. Any one who is familiar with the powerful influence of the Appalachian barrier in our history is surprised to read that, "When the white men, hav-

ing settled along the Atlantic coast, began to push their way westward they encountered no geographical obstacles." But this is a small fault in a scholarly and useful volume. A. P. B.

*Mont Pelée and the Tragedy of Martinique, by Angelo Heilprin. 8vo, 335 pp., with map and many illustrations. J. B. Lippincott Company.*

Professor Heilprin's reputation as an observer and writer would lead one to anticipate a vivid and authoritative presentation of the great catastrophe. This expectation is fulfilled in the volume before us. We have the story of three ascents of Pelée, and of some weeks spent in its neighbourhood, as well as the accounts of resident observers here reproduced. The author brings out very fully the alarming events of the days preceding the cataclysm of May 8, and makes the false security of the people seem incomprehensible. The warnings would certainly have been heeded but for the authority of a few trusted advisers.

Naturally, among the absorbing chapters are those describing "the last day of Saint Pierre" (V), the destruction of May 8 (III), and the author's third ascent, that of August 30, on the evening of which Morne Rouge was destroyed and a large additional region devastated (Battling with Pelée, Ch. XV). Chapter XII has deep interest in its story of the tragic end of the devoted Père Mary, faithful to his spiritual charge to the last. Chapter VIII draws a parallel between Pelée and Vesuvius, and places some interesting question marks upon the ordinary geological teaching about Vesuvius. The closing chapter reviews in a summary way the phenomena of the eruption. Perhaps the passage of greatest interest in this chapter gives the author's conclusions as to the origin and aiming of the fiery blast that destroyed Saint Pierre:

A volume of steam with intense explosive energy rising to the crater-mouth, blowing out in its first paroxysm a part of the crater-floor, and then exploding in free air under a heavily-depressing cushion of ascending steam and ash, and with surrounding walls of rock on three sides and more to form an inner casing to nature's giant mortar. The blast was forced through the open cut, or lower lip of the crater, that was directed to Saint Pierre.

A. P. B.

*The Hudson River, from Ocean to Source, by Edgar Mayhew Bacon, with 100 illustrations, and with sectional map of the Hudson River. 590 pp. G. P. Putnam's Sons.*

This volume is uniform in appearance and in general character with Reid's Mohawk Valley, issued from the same press one year earlier. It is described upon the title page in the words Historical—

Legendary—Picturesque—on the whole a truthful designation. While professing to deal with the entire river, more of the chapters are given to the lower Hudson, with its ample history. The work is geographical in a secondary sense only, but places events in their scenic settings effectively. A rather scanty chapter of twenty-two pages is devoted to the river above tide-water. The first chapters give many good pictures of the first settlements, the manners, pageants, and social gatherings of old New York. Then come gossipy stories of Fulton's steamboat, and the "Passing of the White Wings," and of the "Land of Irving and the Literary Associations of the Hudson," recalling not only Irving, but Halleck, Hoffman, Drake, Willis, Beecher, Burroughs, Downing the landscape architect, and many others. The military movements of the Highlands are not neglected, and, altogether, the Dutch, the English, town, forest, mountain, and river are placed before us with a ready pen, and suitably to the reader who would have real history and real geography, but would not care to take either too seriously. The illustrations are in part from photographs, and in many cases from old engravings, and both sorts are, as a rule, equally good.

A. P. B.

*The Romance of the Colorado River, by Frederick S. Dellenbaugh. 8vo, 399 pp. G. P. Putnam's Sons.*

This volume, as its title implies, is a popular rather than scientific description of the great river. But the author shows himself familiar with the classical writings of Powell, Dutton, and Gilbert, and has a first-hand knowledge of the stream and its cañons from much sojourning in the region, and particularly from being associated with Powell in the latter's second exploration of 1871 and 1872. The work is more than a compilation, therefore, though it owes much to the report of Ives, and to Powell's brilliant narrative of the uniquely successful running of the cañon in 1869. The illustrations are abundant, being about two hundred in number, largely from photographs, ranging in locality from Wyoming to the Gulf of California. The early Spanish explorers, the missionary Fathers and the trappers occupy the early chapters, and then come Ashley, Hardy, Fremont, and others. Chapter VII is given to Ives, and the next two are devoted to the "One-armed Knight" and his voyage of 1869. Powell's second expedition is treated more in detail, as is natural, from the author's connection with it. The last chapter includes the story of Brown's unfortunate expedition. An epilogue contains a sympathetic sketch and a good portrait of Major

Powell, whose name will always be linked with this strange river and its unrivalled cañon. The appendix gives a somewhat detailed profile from the Wind River Mountains to the Gulf of California.

A. P. B.

*F. von Bellingshausens Forschungsfahrten im Südlichen Eismeer, 1819-1821. Auf Grund des russischen Originalwerks herausgegeben vom Verein für Erdkunde zu Dresden. Leipzig, S. Hirzel. 1902. pp. 204.*

In 1831 the Russian explorer Bellingshausen published in St. Petersburg, in two quarto volumes, his account of the two important voyages he had made into the Antarctic regions. His routes have long been depicted on all the best maps of the South Polar waters, but his narrative has had very few readers outside of Russia, for it has never been translated into any other language. The largest results of his work have been well summarized by Dr. Karl Fricker and some other writers, but many valuable features of Bellingshausen's researches, particularly in the domain of physical science, have not been accessible to most scientific men.

The explorer's book, however, was so voluminous that the Dresden Geographical Society decided not to assume the expense of publishing a translation of the entire work, which had been prepared by Professor H. Gravelius, and which, if published, would have been more than three times as long as the condensation by Professor Gravelius, which has now appeared.

This gives a literal translation, as far as possible, of Bellingshausen's book in all matters of larger scientific interest, such as the determination of geographical positions, meteorological and physical observations, etc. Professor Gravelius has suppressed or subordinated the descriptive features of the narrative, such as Bellingshausen's sketches of his visits to various ports and islands and other of the lighter features of the book. It is scarcely necessary to say that the German version of Bellingshausen is, therefore, better adapted for scientific readers than for the general public. With the revival of research in the Antarctic regions this reproduction in a language widely known of the most valuable parts of Bellingshausen's work is very timely.

*The Uganda Protectorate. An attempt to give some description of the Physical Geography, Botany, Zoology, Anthropology, Languages, and History of the Territories under British Protection in East Central Africa between the Congo Free State and the Rift Valley, and between the First Degree of South Latitude and the Fifth*

*Degree of North Latitude.* By Sir Harry Johnston, G.C.M.G., K.C.B., etc. In 2 vols. 506 illustrations from drawings and photographs, 48 full-page coloured plates and 9 maps. Hutchinson & Co., London, 1902.

Uganda has attracted more attention since the narratives of Speke, Grant, and Stanley first appeared than any other part of tropical Africa, excepting the Congo Free State, partly because its native government was interesting, as being the most powerful and compact political organization in equatorial Africa, and also because the European teachers living in Uganda have been more successful than in any other part of the continent in establishing schools, churches, hospitals, and the printing press. Many books have been written about Uganda, but Sir Harry Johnston's very long work of 1,018 pages, devoted to the whole area embraced within the Uganda Protectorate, gives an amount of description and information that is scarcely to be found in any other work on Africa. Little or none of the book is given to the details of travel, but, on the contrary, it is all a record of observation and study relating to many aspects of the country and its people, and largely of a scientific character. It is one of the best outcomes yet observed of the new phase of African exploration—the era of detailed and minute study in comparatively small fields, which has succeeded the days of pioneer discovery and of routes traced across the continent.

Natural history has a very prominent place in the work, as in every book that the author has written; but the whole is an encyclopædia of information on an unusually interesting part of Africa. The hundreds of illustrations of landscapes, people, and animal life are illuminative, and the nine maps are produced in the superior manner of the Bartholomew map house of Edinburgh. They include political and orographical maps of the Protectorate and others, showing the density of native population and the distribution of rainfall, navigable waterways, vegetation, native races, language groups, and religions. The author takes a very hopeful view of the commercial prospects of the country, now that the Uganda Railroad connects the Victoria Nyanza with the Indian Ocean.

*Complete Geographic Description of the Russian Empire.* Prepared under the direction of P. N. Siemienov and V. I. Lamanski. Editor V. P. Siemienov. Vol. II. *The Black Earth Region of Middle Russia.* Devrien, St. Petersburg, 1902. (In Russian.)

This large work on Russia undertaken by Mr. Devrien is pro-

gressing. The newly-published volume is devoted to the Black Earth region, including the provinces of Ryazan, Tula, Orlov, Tambov, Penza, Voronezh, and Kursk. The book describes the topography, geological formation, rivers, soils, climate, fauna, and other features. Particularly detailed descriptions are given of the more densely-peopled regions in the order of their distribution along the railroad lines or tributary to them. The book has 123 illustrations, 35 diagrams, and one large and ten small maps.

*On the Lakes of Southeastern Wisconsin.* By N. M. Fenneman, Ph.D., Professor of Geology, University of Colorado. Pp. 178, Index, 36 plates of half-tone illustrations, 38 figures in the text and a small geological map of Wisconsin. (No. VIII. of the Wisconsin Geological and Natural History Survey, Educational Series, No. 2.) Madison, Wis., 1902.

This well-written and interesting volume is devoted to the physical geography of the lakes of Wisconsin, and is specially intended to assist teachers in the southeast part of the State to use the natural features of that region as an aid to understanding the principles of physical geography and geology. Teachers and students who may visit these beautiful lakes for purposes of physiographical study are to be congratulated upon having so helpful a guide.

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#### NOTES AND NEWS.

THE NEXT MEETING of the Society will be held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, the 17th of March, 1903, at 8.30 o'clock P.M.

Mr. Harry de Windt will address the Society on the incidents of a journey From Paris to New York by Land.

On the 14th of April Mr. E. L. Corthell will recount his observations and experiences during Two Years in Argentina as Consulting Engineer of the Ministry of Public Works.

Prof. E. L. Stevenson's paper on Martin Waldseemüller and the Earliest Cartography of the New World (announced for the 17th of February and postponed on account of a snowstorm) will be read before the Society in November.

The Peary steamer *Windward*, presented five years ago to Mr.

Peary by Mr. Alfred C. Harmsworth, of London, was sold in February to Capt. Bernhard Jensen, of Christiania, Norway. Built at Peterhead, Scotland, about forty years ago for the whale fishery, the *Windward* has passed three winters in the Arctic—the first in 1894-95, at Franz Josef Land, whence, after landing the Jackson-Harmsworth party, she was unable to extricate herself; the second, at Allman Bay, seventy miles north of Cape Sabine, on the eastern coast of Grinnell Land, as Commander Peary's headquarters during the winter of 1898-9; and the third at Payer Harbour, near Cape Sabine, with Mrs. Peary and Miss Peary on board, in the winter of 1900-01, where Commander Peary came on board May 6, 1901, on his journey southward from Fort Conger. The *Windward* has twice been thoroughly repaired by the Peary Arctic Club, new engines of high power, giving her more than double the former speed, having been installed at the Newburgh (N. Y.) works of T. C. Marvel & Co., last summer.

Capt. Jensen, Commander of the *Antarctic* and Sir George Newnes' *Southern Cross*, in their voyages to the South polar zone, will transfer the *Windward* to a corporation to carry on whaling under the Russian flag, in East Asiatic waters. Thence she will proceed by way of Kerguelen Island for sea lions and seal to be sold at Melbourne, Australia, in February of next year, and be associated with the *Rex*, which made a successful cruise last year in waters found profitable by the Japanese. The *Windward* will be fitted for her new work at Christiania.

A series of observations has been made by the United States Geological Survey on certain streams in the Catskill region and lower Hudson Valley, which are being studied in connection with possible future use for the supply of New York City. The results of the investigation are published in No. 76 of the series of Water-Supply and Irrigation Papers.

One of the objects of hydrographic engineers in measuring the flow of streams has been to determine the line of mean velocity of the flowing water. Through experiments on the Catskill, Esopus, Rondout, and Fishkill creeks and on the Wallkill and Housatonic Rivers it has been ascertained that the mean velocity for small vertical sections 5 to 10 feet in width is found at or very near a point six-tenths the depth of the stream.

The same investigations were carried on when these streams were frozen over, and it was noted that the ice-covering had the effect of making two points of mean velocity in any given vertical

section—namely, at approximately 0.13 and 0.73 of the total depth measured from the bottom of the ice.

In addition to these studies, observations were made to determine the amount of turbidity, colour, alkalinity, and hardness of the waters of these streams under the varying conditions of high and low stages.

## TRANSACTIONS OF THE SOCIETY.

JANUARY—FEBRUARY, 1903.

The Annual Meeting of the Society was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, January 27, 1903, at 8.30 o'clock P.M.

Vice-President Moore in the chair.

The following persons, recommended by the Council, were elected Fellows:

William Redmond Peters, John R. Gibney, Edward D. Adams.

The Annual Report of the Council was then submitted and read:

NEW YORK, January 8, 1903.

*To the American Geographical Society:*

The Council respectfully submit the following report for the year 1902:

The number of Fellows on the 1st of January was 1,206. The additions during the year number 85. The losses by death, resignation, etc., were 93, and the total Fellowship on the 31st of December was 1,198, of which number 345 were Life Fellows.

The additions to the Library number 3,673: Periodicals and Pamphlets, 2,618; Books, 734; Maps and Charts, 298, and Atlases, 23.

Six meetings of the Society were held in the year:

On the 21st of January Mr. Alden Sampson described his visit to Palmyra;

On the 18th of February Mr. Richard E. Dodge read a paper on Life Conditions in a Desert, with special reference to the Southwestern United States;

On the 18th of March M. Hugues Le Roux described in French a Visit to the Emperor Menelik;

On the 15th of April Mr. Carl Lumholtz read a paper on the Huichol Indians of Mexico;

On the 18th of November Civil Engineer R. E. Peary addressed the Society on the work of the Peary Arctic Club in the Arctic, 1898-1902;

On the 23d of December Mr. George S. Morison addressed the Society on the Panama Canal.

There have been published in the BULLETIN, besides the Record and Scientific Notes and Letters, Seventeen original papers.

The house No. 11 West 29th St., for so many years the home of the Society, has been sold for \$75,000.

For the condition of the finances reference is respectfully made to the report of the Treasurer, herewith presented.

The receipts, other than ordinary, have been as follows :

Legacies : from the Estate of Charles P. Daly.....	\$16,877.83
"      "      "      "      S. F. B. Morse.....	1,000.
Donations.....	11,786.37

The legacy of \$1,000 from the Estate of Mr. S. F. B. Morse is to be appropriated, according to the provisions of his Will,

"towards the procuring of a suitable medal for the encouragement of geographical research."

The Will of Mr. Morse was made in 1872. In the present condition of the money market this sum will not produce an income sufficient to pay for a medal worthy of the name of Mr. Morse or likely to be acceptable to geographers of distinction. Therefore it has been decided to invest the amount at compound interest until the fund shall increase to a sum sufficient to produce an income adequate to carry out the designs of Mr. Morse.

Respectfully submitted,

LEVI HOLBROOK,  
*Secretary.*

HENRY PARISH,  
*Chairman.*

#### The Report of the Treasurer was then read:

The Treasurer respectfully reports that on January 1st there was on hand a cash balance of.....	\$10,460.35
During the year there have been received for Fellowship Dues, Sales of Publications and interest on investments.....	16,707.79
Legacies and Donations.....	31,642.77
Proceeds of sale of No. 110 West 29th St. ....	\$75,000.00
Less remaining on mortgage at 4%.....	50,000.00
	25,000.00
	<hr/>
	\$83,810.91
There has been expended for Salaries, Library, Meetings, Publications, House expenses, Insurance, Postages, Furnishings, &c.....	\$16,393.21
On account of New Building.....	6,791.12
Invested.....	53,500.00
	<hr/>
	76,684.33
On December 31st cash balance in Bank.....	7,126.58

The Committee charged with the duty of selecting candidates for the offices to be filled made the following Report:

NEW YORK, January 8, 1903.

*To the Council of the American Geographical Society:*

The Committee appointed to recommend to the Society suitable persons to be elected in January, 1903, to fill vacancies then existing in its offices respectfully

report that they recommend the election of the following-named persons to the offices below designated :

President—ROBERT E. PEARY.  
 Vice-President—W. H. H. MOORE.  
 Foreign Corresponding Secretary—WILLIAM LIBBEY.  
 Treasurer—WALTER R. T. JONES.  
 Councillors—FRANCIS M. BACON,  
                   JOHN GREENOUGH,  
                   JAMES J. HIGGINSON,  
                   S. NICHOLSON KANE,  
                   M. TAYLOR PYNE.

FRANCIS M. BACON, }  
 JOHN GREENOUGH, } *Committee.*  
 CHANDLER ROBBINS, }

On motion, duly seconded, Mr. Cyrus C. Adams was authorized to cast the vote of the Society for the candidates, and they were declared duly elected.

Mr. William Libbey then addressed the Society on his recent visit to the Jordan Valley and Petra.

On motion, the Society adjourned.

A Regular Meeting of the Society was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, February 17th, 1902, at 8.30 o'clock P.M.

President Peary in the chair.

The following persons, recommended by the Council, were elected Fellows:

Otto Gerdau.	Rufus H. Wood.
William Sellers.	Frederick Strauss.
Henry R. Wood.	William H. Wallace.

Henry R. Taylor.

The President explained to the Society that the very heavy fall of snow had prevented the arrival of the apparatus for illustrating the lecture announced for the evening, and introduced Prof. E. L. Stevenson, who gave a summary of his address on Martin Waldseemüller and the Earliest Cartography of the New World.

On motion, the Society adjourned.

# THE AMERICAN GEOGRAPHICAL SOCIETY OF NEW YORK

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## Council

<i>President,</i>	- - - -	ROBERT E. PEARY, C.E., U.S.N.
<i>Vice-Presidents,</i>	- - - -	{ D. O. MILLS, W. H. H. MOORE C. C. TIFFANY, D.D.
<i>Treasurer,</i>	- - - -	WALTER R. T. JONES
<i>Foreign Corr. Secretary,</i>	- -	WILLIAM LIBBEY
<i>Domestic Corr. Secretary,</i>	-	CHANDLER ROBBINS
<i>Recording Secretary,</i>	- - -	ANTON A. RAVEN

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## Councillors

FRANCIS M. BACON	LEVI HOLBROOK
GEORGE S. BOWDOIN	HENRY HOLT
CHARLES S. FAIRCHILD	MORRIS K. JESUP
JOHN GREENOUGH	S. NICHOLSON KANE
JOHN A. HADDEN	GUSTAV E. KISSEL
WILLIAM G. HAMILTON	HENRY PARISH
JAMES J. HIGGINSON	M. TAYLOR PYNE
HERMAN C. VON POST	

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Candidates for admission into the Society must be proposed and seconded by Fellows.

There is no admission fee. The initial payment and dues of a Fellow for the first year are \$10; and the dues \$10 yearly thereafter, payable in advance on the 1st of January.

Life Fellowship, free from all dues, \$100.

The privileges of a Fellow include admission to the Meetings of the Society and the use of the Library and Map-room, and entitle him also to a copy of all the Society's periodical publications issued during his Fellowship.